Vol. I

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1935

No. 388

A. G. TRIPLETT, R. M. TRIPLETT, A. NELSON, ET AL., PETITIONERS,

vs.

PERCIVAL D. LOWELL, FRANCIS W. DUNMORE, AND DUBILIER CONDENSER CORPORATION

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FOURTH CIRCUIT

PETITION FOR CERTIORARI FILED AUGUST 21, 1935.

CERTIORARI GRANTED DECEMBER 9, 1935.

SUPREME COURT OF THE UNITED STATES

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TRANSCRIPT OF RECORD

UNITED STATES OF AMERICA,
District of Maryland, to wit:

At a District Court of the United States for the District of Maryland, begun and held in the City of Baltimore on the first Tuesday in June, (being the 5th day of the same month) in the year of our Lord One Thousand Nine Hundred and Thirty-Four.

Present: The Honorable William C. Coleman, Judge Maryland District; Bernard J. Flynn, Esq., Attorney; August Klecka, Esq., Marshal; Arthur L. Spamer, Clerk.

Among other were the following proceedings, to wit:

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation,

Plaintiffs,

vs.

A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and the Baltimore Gaslight Company,

Defendants.

In Equity No. 2193

BILL OF COMPLAINT.

Filed 17th August, 1933.

UNITED STATES DISTRICT COURT, DISTRICT OF MARYLAND.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs, vs. A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and the Baltimore Gaslight Company, Defendants.	In Equity No. 2193 On U. S. Letters Patent Nos. 1,455,141 1,606,212 1,635,117

To the Honorable the Judges of the District Court of the United States for the District of Maryland:

The plaintiffs by this bill of complaint allege as follows:

1. The plaintiff Percival D. Lowell is a citizen of the United States and a resident of Washington, District of Columbia; and the plaintiff Francis W. Dunmore is a citizen of the United States and a resident of Washington, District of Columbia. The plaintiff, Dubilier Condenser Corporation is a corporation duly organized and existing under and by virtue of the laws of the State of Delaware, and a citizen, resident and inhabitant of said state.

2. On information and belief that the defendant Baltimore Gaslight Company is a partnership composed of the defendants A. G. Triplett, R. H. Triplett, A. Nelson and C. M. Triplett, Jr., that all of said individual defendants are inhabitants of the State of Maryland and together with the defendant Baltimore Gaslight Company maintain offices in the City of Baltimore, in the District and State of Maryland.

3. That the above named defendants within the District of Maryland and elsewhere in the United States have committed within the last six years and are now

continuing and threatening to continue to commit the acts of infringement complained of herein.

4. That this is a suit in equity brought under the Patent Laws of the United States for infringement of the hereinafter mentioned United States Letters Patent No. 1,455,141; No. 1,606,212 and No. 1,635,117 issued respectively on May 15, 1923, November 9, 1926 and July 5, 1927.

5. Upon information and belief, that Percival D. Lowell and Francis W. Dunmore, citizens of the United States, and, under the laws of the United States then in force, the first, true, original and joint inventors of certain new and useful improvements in radio receiving apparatus, did on March 27, 1922, duly make and file an application in writing with the Commissioner of Patents of the United States for Letters Patent upon said improvements and that at the time of making application, said improvements had not been known or used by others in this country, and had not been patented or described in any printed publication in this or any foreign country, before their invention or discovery thereof, or more than two years prior to their application aforesaid, and had not been in public use or on sale in this country for more than two years prior to their application aforesaid, and had not been patented in any country foreign to the United States on any application filed by them or their legal representatives or assigns more than twelve months prior to their application aforesaid, and had not been abandoned.

6. That Letters Patent numbered 1,455,141 was, on May 15, 1923, duly issued upon the aforesaid application filed March 27, 1922, all the provisions and requirements of the statutes of the United States in such case made and provided having been duly complied with, said patent being issued to said Percival D. Lowell and Francis W. Dunmore, their heirs and assigns, whereby there was granted to them for the term of seventeen years from the date thereof, the right to exclude others from making, using, vending, the invention and improvements set forth, described and claimed therein, throughout the United States and territories thereof. That thereafter on or about July 8, 1933, the plaintiffs herein entered a disclaimer in the United States Patent Office disclaim-

ing portions of said Letters Latent which through inadvertence, accident or mistake were too broad, including that of which said patentees were not the first inventors all of which will more fully and at large appear by reference to the said letters patent and disclaimer or duly certified copies ready in court to be produced.

7. Upon information and belief, that Francis W. Dunmore and Percival D. Lowell, citizens of the United States and under the laws of the United States then in force, the first, true, original and joint inventors of certain new and useful improvements in signal receiving systems, did on March 21, 1922, duly make and file application in writing with the Commissioner of Patents of the United States for letters patent upon said improvements; and that at the time of making said application, said improvements had not been known or used by others in this country, and had not been patented or described in any printed publication in this or any foreign country, before their invention or discovery thereof, or more than two years prior to their application aforesaid, and had not been in public use or on sale in this country for more than two years prior to their application aforesaid, and had not been patented in any country foreign to the United States on any application filed by them or their legal representatives or assigns more than twelve months prior to their application aforesaid, and had not been abandoned.

8. That Letters Patent Numbered 1,606,212 was, on November 9, 1926, duly issued upon the aforesaid application filed March 21, 1922, all the provisions and requirements of the Statutes of the United States in such case made and provided having been duly complied with, said patent being issued to said Francis W. Dunmore and Percival D. Lowell, their heirs and assigns, whereby there was granted to them for the term of seventeen years from the date thereof, the right to exclude others from making, using and vending, the invention and improvement set forth, described and claimed therein, throughout the United States and territories thereof, all of which will more fully and at large appear by reference to the said letters patent or a duly certified copy thereof ready in court to be produced.

9. Upon information and belief, that Francis W. Dunmore, a citizen of the United States and under the laws of the United States then in force, the first, true, original and sole inventor of certain new and useful improvements in signal receiving systems, did on February 27, 1922, duly make and file application in writing with the Commissioner of Patents of the United States for letters patent upon said improvements; and that at the time of making said application, said improvements had not been known or used by others in this country, and had not been patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application aforesaid, and had not been in public use or on sale in this country for more than two years prior to his application aforesaid, and had not been patented in any country foreign to the United States on any application filed by him or his legal representatives or assigns more than twelve months prior to his application aforesaid, and had not been abandoned.

10. That Letters Patent Numbered 1,635,117, was, on July 5, 1927, duly issued upon the aforesaid application filed February 27, 1922, all the provisions and requirements of the Statutes of the United States in such case made and provided having been duly complied with, said patent being issued to said Francis W. Dunmore, his heirs and assigns, whereby there was granted to him and them for the term of seventeen years from the date thereof, the right to exclude others from making, using and vending, the invention and improvement set forth, described and claimed therein, throughout the United States and territories thereof. That thereafter on or about July 8, 1933, the plaintiffs, Francis W. Dunmore and Dubilier Condenser Corporation, entered a disclaimer in the United States Patent Office disclaiming portions of said Letters Patent which through inadvertence, accident or mistake were too broad, including that of which said patentee was not the first inventor all of which will more fully and at large appear by reference to the said patent and disclaimer or duly certified copies thereof ready in court to be produced.

11. That upon information and belief by means of certain agreements executed October 20, 1924, May 19,

1927 and July 15, 1927, Dubilier Condenser Corporation, one of the plaintiffs herein, became vested with full rights as exclusive licensee together with the right to sue for infringement of said patents all of which will more fully and at large appear by reference to said agreements or duly certified copies thereof ready in court to be produced; that by authority of said agreements and the rights arising thereunder the plaintiff, Dubilier Condenser Corporation, has jointed the said Percival D. Lowell and Francis W. Dunmore as co-plaintiffs, and has signed their names to this bill of complaint and has notified them thereof.

12. That the plaintiff, Dubilier Condenser Corporation as been ever since October 20, 1924, May 19, 1927 and July 15, 1927, respectively, and now is the exclusive licensee under said patents, together with the right to sue for infringement of said patents, and the plaintiffs, Percival D. Lowell and Francis W. Dunmore, the joint owners of the legal title to said Letters Patent No. 1,455,141 and 1,606,212, and the plaintiff, Francis W. Dunmore, the owner of the legal title to said Letters Patent 1,635,117 and all rights in said Letters Patent and all rights to recoveries thereunder are and have been since October 20, 1924, May 19, 1924 and July 15, 1927, respectively vested in the plaintiffs as aforesaid.

13. That the inventions and improvements of said Letters Patent Nos. 1,455,141, 1,606,212 and 1,635,117 are of great value and importance and benefit to the public; that plaintiffs Percival D. Lowell and Francis W. Dunmore and plaintiff Francis W. Dunmore respectively, reduced the inventions thereof to practice and sought to introduce the same upon the market; to that end said plaintiffs licensed plaintiff Dubilier Condenser Corporation and others and plaintiff Dubilier Condenser Corporation has granted licenses under said Letters Patent to others; and said licensees have placed devices on the market using and embodying the inventions of said Letters Patent; plaintiff Dubilier Condenser Corporation acting under its license invested large sums in developing, perfecting, making and marketing apparatus employed in carrying out said inventions; and the inventions have gone into large use and said Letters Patent have been infringed upon to a large extent.

That plaintiff Dubilier Condenser Corporation filed bills of complaint in the United States District Court for the District of Delaware on or about September 20, 1927 against the Radio Corporation of America charging infringement upon certain claims of said Letters Patent; that on or about August 12, 1929, the said District Court entered its decree adjudging claims 3 and 14 of said Letters Patent No. 1,455,141 to be valid and infringed and adjudging claim 9 of said patent No. 1,635,117 to be valid and infringed; that thereupon the said defendant Radio Corporation of America perfected an appeal from the said decision to the United States Circuit Court of Appeals for the Third Circuit, which Court reversed the aforesaid decree of the District Court for the District of Delaware and held said claims invalid and directed the said bills of complaint to be dismissed; that the said decree of the District Court held the said patent No. 1,606,212 not to be infringed and no appeal was taken from said decree with respect to said patent No. 1,606,212; that a petition for rehearing was filed in the said Circuit Court of Appeals with respect to the decision of that Court upon claim 9 of patent No. 1,635,117, which petition was denied; that thereafter plaintiff filed petitions in the Supreme Court of the United States for writs of certiorari to review said decisions of the Circuit Court of Appeals for the Third Circuit with respect to said patent Nos. 1,455,141 and 1,635,117 and the Supreme Court of the United States denied said petitions on or about October 25, 1932; and thereafter and on or about July 8, 1933, plaintiffs herein filed the disclaimers recited in paragraphs 8 and 10 hereof.

14. Upon information and belief that apparatus made under said letters patent by the plaintiff Dubilier Condenser Corporation and by the several licensees under said patents was duly marked "Patented" with the patent number and date thereof in accordance with the statute.

15. On information and belief that the said defendants and each of them without license or permission and in violation, infringement and contributory infringement of said Letters Patent No. 1,455,141, contriving to injure plaintiffs and to deprive them of the benefits and advantages which might and otherwise would accrue unto them

from said invention, after the issue of said Letters Patent as aforesaid and within six years before the commencement of this suit and prior to the execution of this bill of complaint, did wrongfully and unlawfully sell and use within the District of Maryland and elsewhere within the United States, and are now selling and using, and threatening to continue to sell and use within the District of Maryland and elsewhere within the United States large quantities of radio receiving apparatus, and that said apparatus employs and embodies the invention and improvements of said Letters Patent No. 1,455,141 and infringes said letters patent; and the said defendants and each of them has further, aided and abetted others to commit similar infringements of said patent.

On information and belief that the said defendants and each of them without license or permission and in violation, infringement and contributory infringement of said Letters Patent No. 1,606,212, contriving to injure plaintiffs and to deprive them of the benefits and advantages which might and otherwise would accrue unto them from said invention after the issue of said letters patent as aforesaid and within six years before the commencement of this suit and prior to the execution of this bill of complaint, did wrongfully and unlawfully sell and use within the District of Maryland and elsewhere within the United States, and are now selling and using and threatening to continue to sell and use within the District of Maryland and elsewhere within the United States large quantities of power amplifiers and that said apparatus employs and embodies the invention and improvements of said Letters Patent No. 1,606,212, and infringes said letters patent; and the defendants and each of them has further, aided and abetted others to commit similar infringements of said patent.

On information and belief that the said defendants and each of them without license or permission and in violation, and infringement and contributory infringement of said letters patent No. 1,635,117, contriving to injure plaintiffs and to deprive them of the benefits and advantages which might and otherwise would accrue unto them from said invention after the issue of said letters patent as aforesaid and within six years before the commencement of this suit and prior to the execution of this bill of complaint, did wrongfully and unlawfully sell and use

within the District of Maryland and elsewhere within the United States, and are now selling and using and threatening to continue to sell and use within the District of Maryland and elsewhere within the United States large quantities of signal receiving systems embodying and employing the invention and improvements of said Letters Patent No. 1,635,117 and infringing said letters patent; and the defendants and each of them, has aided and abetted others to commit similar infringements of said patent.

On information and belief that the defendants herein and each of them has derived and received and will derive and receive from the aforesaid infringement and contributory infringement complained of herein, great gains profits and advantages, but to what amount the plaintiffs are ignorant and cannot set forth; that by reason for the said infringement and contributory infringement the plaintiffs have been and will be deprived and prevented from receiving, if such infringement and contributory infringement are not forthwith restrained by this court, all of the gains and profits to which the plaintiffs are lawfully entitled, and which they would have derived and received, and would now be deriving and receiving, but for the aforesaid infringement and contributory infringement; that by reason of the aforesaid infringement and contributory infringement the plaintiffs have been irreparably injured and have sustained damages and losses thereby; that the aforesaid infringement and contributory infringement has had the effect to and does encourage and induce, aid and abet, others to venture to infringe upon and contribute to the infringement of said letters patent, and unless the aforesaid infringement and contributory infringement are immediately enjoined by a writ of injunction issuing out of this court, further and irreparable injury, loss or damage will be caused to the plaintiffs.

16. That, upon information and belief, the defendants have been duly notified of said letters patent and of its infringement of said letters patent, but nevertheless continue to infringe whereby the defendants have profited and the plaintiffs have been damaged.

The plaintiffs therefore pray:

1. That a subpoena issue out of and under the seal of this court requiring said defendants A. G. Triplett,

R. M. Tripplett, A. Nelson, C. M. Triplett, Jr., and the Baltimore Gaslight Company and each of them to appear and make full, true, direct and perfect answer to the several matters and things set forth and charged in this bill of complaint.

2. That the said defendants and each of them, their servants, agents and employees, be perpetually enjoined and restrained by the decree of this Court from directly or indirectly making or causing to be made, using or causing to be used, leasing or causing to be leased, selling or causing to be sold, advertising or offering for sale, use or lease, or causing to be advertised or offered for sale, use or lease, agreeing or contracting to sell or lease, or causing to be agreed or contracted for sale or lease, supplying or causing to be supplied, installing or causing to be installed, or threatening to make, use, lease, sell, supply or install, or threatening to offer or contract for sale, lease or supply, or disposing of in any manner, any signal receiving systems, radio receiving apparatus, power amplifiers, or other apparatus containing or embodying said inventions and improvements or involving the use of the said inventions and improvements of said letters patent Nos. 1,455,141, 1,606,212 and 1,635,117 or any of them or any substantial, material, or vital part or parts thereof, and from infringing upon or contributing to the infringement of said letters patent in any way whatsoever.

3. That a provisional or preliminary injunction issue against the said defendants and each of them to the same tenor and effect as hereinbefore prayed for in respect to said perpetual injunction.

4. That the said defendants and each of them be ordered and decreed to deliver to the plaintiffs each and all of the said infringing signal receiving systems, radio receiving apparatus, power amplifiers, and/or other apparatus embodying said inventions and improvements and material and vital parts thereof, which it has in its possession or under its control, or that they be destroyed, or that they be delivered into court or be impounded by the court, or such other disposition be made thereof as to the court may seem just and proper.

5. That the said defendants and each of them may be decreed to account to the plaintiffs for all such gains, profits and advantages, as have accrued to or have been earned or received by the said defendants, from the aforesaid infringement, and contributory infringement, and all such gains, profits and advantages as would have accrued to or been earned by the plaintiffs, but for the infringement and contributory infringement and also all damages the plaintiffs have sustained by said infringement and contributory infringement, and that the court will assess the same, or cause them to be assessed under its direction, and will increase the same in its discretion as provided by law.

6. That the said defendants and each of them may be decreed to pay the costs, charges and disbursements of this suit, and that the plaintiffs may have such other and further relief as the premises and the equity of the case may require and to the Court may seem just.

PERCIVAL D. LOWELL,

By DUBILIER CONDENSER CORPORATION,

By MORTON JOYCE,

Treasurer.

FRANCIS W. DUNMORE,

By DUBILIER CONDENSER CORPORATION,

By MORTON JOYCE,

Treasurer.

DUBILIER CONDENSER CORPORATION,

By MORTON JOYCE,

Treasurer.

SEMMES, BOWEN & SEMMES,

Solicitors for Plaintiffs.

CLIFTON V. EDWARDS,

Of Counsel.

State of New York, County of New York, ss:

MORTON JOYCE, being duly sworn, deposes and says that he is Treasurer of the Dubilier Condenser Corporation, one of the plaintiffs named in the foregoing bill of complaint; that he has read the same and knows the contents thereof and that the same is true of his own knowledge except as to the matters therein stated to be alleged on information and belief and as to those matters he believes it to be true; that the reason why this verification is not made by the plaintiff personally is that the said plaintiff is a corporation.

MORTON JOYCE,

Subscribed and sworn to before me this 14 day of August, 1933.

DOROTHY L. DAVIS,
Notary Public.

(Seal.)

MEMORANDUM.

Patent No. 1,455,141—referred to in Paragraph 6 of Bill of Complaint, No. 1,606,212 referred to in Paragraph 8 of Bill of Complaint, and No. 1,635,117, referred to in Paragraph 10 of Bill of Complaint, are here omitted, said patents being incorporated in Volume II—Book of Exhibits, at pages 2-11, 12-23 and 373, respectively.

ANSWER TO BILL OF COMPLAINT.

Filed 21st September, 1933.

(Style of Court and Title Omitted.)

For answer to the bill of complaint herein, or to as much thereof as it is deemed material or necessary to be answered defendants, on information and belief, say:

1. Defendants have no information, save that obtained from the bill of complaint, as to the matters alleged in paragraph 1 thereof and leave plaintiffs to their proof.

2. Defendants deny each and every allegation contained in paragraphs 5, 6, 7, 8, 9 and 10 of the bill of complaint except they admit having seen what purported to be printed copies of United States Letters Patent Nos.

1,455,141, 1,606,212, and 1,635,117 issued, respectively, on May 15, 1923, November 9, 1926, and July 5, 1927.

3. Defendants are without information save that obtained from the bill of complaint, as to the matters alleged in paragraphs 11 and 12 thereof and leave plaintiffs to their proof.

4. Answering paragraph 13 of the bill of complaint defendants admit the matters therein alleged pertaining to the previous litigation of Dubilier Condenser Corporation vs. Radio Corporation of America in the United States District Court for Delaware, and in the United States Circuit Court of Appeals for the Third Circuit, the tenor and effect of the decrees thereof, and the petition to and denial by the Supreme Court of the United States; but deny each and every other allegation of this paragraph except that herein specifically admitted, except as to the matter of disclaimer, as to which defendants are not informed, save by the bill of complaint, and therefore leave plaintiffs to their proof.

5. Defendants are without information as to the matters alleged in paragraph 14 of the bill of complaint, save that obtained therefrom, and therefore leave plaintiffs to their proof.

6. Defendants deny each and every allegation contained in paragraph 15 of the bill of complaint.

7. Defendants deny each and every allegation contained in paragraph 16 of the bill of complaint.

Further answering the bill of complaint, on information and belief, defendants aver—

8. That said Letters Patent, and each thereof, are wholly void and invalid at law for each of the following reasons:

(a) Because the alleged invention thereof is shown in printed publications in the United States and/or countries foreign to the United States before the alleged invention or discovery thereof by the said patentees, or more than two years prior to their applications for Letters Patent therefor as follows:

(1) UNITED STATES PATENTS

Inventor	*Patent No.*	*Date of Issue*
Pridham & Jensen	1,105,924	Aug. 4, 1914
Schoemilch et al.	1,087,892	Feb. 17, 1914
White	1,195,632	Aug. 22, 1916
DeForest	1,201,272	Oct. 17, 1916
Hull	1,251,377	Dec. 25, 1917
Heising	1,432,022	Oct. 17, 1922
Hartley	1,442,430	Jan. 16, 1923
Blattner	1,483,273	Feb. 12, 1924
Blattner	1,493,595	May 13, 1924
Hanson	1,529,306	Mar. 10, 1925
Pupin	1,571,458	Feb. 2, 1926

FOREIGN PATENTS

Country	*Inventory*	*Patent No.*	*Date*
France	Barthelemy	526,506	July 2, 1921
France	Vallette	516,753	Dec. 9, 1920

PUBLICATIONS

Author	*Book*	*Date*	*Page*
E. A. White	Electrical Experimenter	July, 1919	234, 266-268
"	"	Sept., 1919	460
"	"	Apr., 1920	1282
E. E. Bucher	Wireless Experimenter's Manual	1920	274-275
V. H. Brown	Radio News	Aug., 1921	111
J. Swank	"	Sept., 1921	201
M. Moye	Wireless World	Apr. 2, 1921	24
"	"	May 14, 1921	103
"	"	Oct. 1, 1921	427
"	Radio News	June, 1921	863
"	"	Aug., 1921	111
"	Annales de Postes Telegraphes et Telephones	Sept., 1921	396-400
Dr. "P. C."	La T. S. F. Moderne	Apr.-July, 1921	129-135
"	"	Aug., 1921	166-173
"	"	Sept., 1921	214-223
McNicol	Electrical Experimenter	May, 1920	39
Abraham & Bloch	Radio Review, Vol. 1	Nov., 1919	100

(2) As to Letters Patent No. 1,606,212—

PUBLICATIONS

Author	*Book*	*Date*	*Page*
Bucher	Vacuum Tubes in Wireless Communication	1918	100-102
Bront	Wireless Age, Vol. 8	Aug., 1921	31-32
Duvall	Q. S. T.	Apr., 1920	18, 20

and other publications, of which defendants are not at present advised, but beg leave to add hereto by proper amendment to this their answer when such information is obtained.

(b) Because the alleged invention of said Letters Patent, and each thereof, did not constitute patentable invention over the then existing state of the art. To show the then existing state of the art reliance will be had on the publications enumerated in paragraph (a) hereof supplemented by—

UNITED STATES PATENTS

Inventor	*Patent No.*	*Date of Issue*
DeForest	879,523	Feb. 18, 1908
Von Lieben	1,038,910	Sept. 17, 1912
White	1,159,307	Nov. 2, 1915
Alexanderson	1,173,079	Feb. 22, 1916
Lowenstein	1,231,764	July 3, 1917
Langmuir	1,273,627	July 23, 1918
Langmuir	1,282,439	Oct. 22, 1918
Schriven	1,375,739	Apr. 26, 1921
Colpitts	1,388,450	Aug. 23, 1921
White	1,394,056	Oct. 18, 1921
Wilson	1,403,932	Jan. 17, 1922
Alexanderson	1,419,797	June 13, 1922
Mathes	1,426,754	Aug. 22, 1922
Heising	1,445,278	Feb. 13, 1923
Pupin	1,446,769	Feb. 27, 1923
Nicolson	1,459,412	June 19, 1923
Nichols	1,463,432	July 31, 1923
Arnold	1,465,332	Aug. 21, 1923
Robinson	1,587,084	June 1, 1926

FOREIGN PATENTS

Country	*Inventor*	*Patent No.*	*Date*
Great Britain	Marconi & Round	28,413	1913
"	"	6,476	1915
"	Lorenz	148,401	1921
Germany	Siemens-Schuckert-Werke G. M. B. H.	312,044	Apr. 28, 1919
"	Hahn	343,060	Oct. 27, 1921

PUBLICATIONS

Author	*Book*	*Date*	*Page*
Morecroft	Principles of Radio Communication	June, 1921	870-871
Not named	Wireless World, Vol. 8	Apr. 17, 1920	64-65
Robert Shute	"	Nov. 12, 1921	499-500
Not named	Wireless World	Dec., 1919	544-547
Sinclair	Wireless World, Vol. 8	Feb. 19, 1921	798, 806, 807
Scott-Taggert	The Electrician	Apr. 23, 1920	451
Horle	Q. S. T. Vol. 3	July, 1920	12-14
Not named	" " 4	Sept., 1920	8,9,35-36
Bussey	" " 4	June, 1921	17-18
Goldsmith	Wireless Age, Vol. 5	Dec., 1917	228, 234-239
Not named	Wireless Age, Vol. 7	Jan., 1920	43
McAusland	Wireless Age, Vol. 7	June, 1920	13-15
Machson	Wireless Age, Vol. 8	Apr., 1921	25-27
White	Wireless Age, Vol. 8	July, 1921	11-17
Not named	Wireless Age, Vol. 8	Aug., 1921	30-31

Reed	Radio News, Vol. 2	Jan., 1921	447-489
"I want to know"	" " " 2	Feb., 1921	540
Marston	" " " 2	June, 1921	870-871
Lewis	" " " 3	Sept., 1921	195, 254
Felder	" " " 3	Sept., 1921	200, 240, 242
Lynch	Science & Invention	Oct., 1921	536, 537, 575
R. C. A. Ad	"	Nov., 1921	669
Guellemin	La T. S. F. Moderne, Vol. 2	Sept., 1921	230-231

and other publications of which defendants are not at present advised, but beg leave to add hereto by proper amendment to this their answer when information thereof is obtained.

(c) Because the patentees named in said Letters Patent, and each thereof, were not the first inventors of the subject matter thereof, but the same had been previously invented by others. In support of this defense, in addition to the patenteees named in the patents applied for prior to the date of filing of the respective applications which matured into the patents in suit enumerated in paragraphs (a) and (b) hereof reliance will be had upon the following:

J. G. Aceves, whose last known address is Columbia University, New York, N. Y.

E. A. White, whose last known address is % Dartmouth College, Hanover, N. H.

and others, information as to whom defendants are not at present advised but beg leave to add hereto by proper amendment to this their answer when such information is obtained.

(d) Because the alleged invention of said Letters Patent, and each thereof, was in public use and/or on sale before the alleged invention thereof by the said patentees, or more than two years prior to their said applications for Letters Patent as follows:

American Telephone and Telegraph Company, a corporation of New York;
Western Electric Company, Inc., a corporation of New York; and
United States Government,

with respect to which latter reference will be had to well known Army and Navy radio receiving sets identified as Navy S. E. 1405, Navy S. E. 1605, Navy S. E. 1605B, Army B. C. 59A, Army B. C. 8A, Army B. C. 103, Army B. C. 105, Navy C. W. 924, C. W. 926, C. W. 927, and Army S. C. R. 68.

(e) With specific reference to patent No. 1,606,212, because the invention for which the patent issued is for a different invention from that for which application for patent was filed, the matter relating thereto having been unlawfully inserted in the application during its prosecution.

9. Defendants, individually and jointly, specifically deny infringement of said Letters Patent, and each thereof.

Wherefore defendants deny each and every allegation of the bill of complaint herein, except such allegations as have been specifically admitted, and deny that plaintiffs are entitled to the relief prayed for, or to any relief, and therefore pray to be hence dismissed with their costs in this case sustained.

A. G. TRIPLETT, R. M. TRIPLETT,
A. NELSON, C. M. TRIPLETT, JR., and
THE BALTIMORE GAS LIGHT COMPANY,
By SAMUEL E. DARBY, JR.,
Attorney for Defendants.

Dated: New York, N. Y., September 19, 1933.

COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Defendants.

DARBY & DARBY,
SAMUEL E. DARBY, JR.,
Of Counsel.

DEFENDANTS' NOTICE, MOTION TO DISMISS AND AFFIDAVIT IN SUPPORT OF MOTION TO DISMISS.

Filed 26th June, 1934.

(Style of Court and Title Omitted.)

NOTICE.

Sir:

Please Take Notice that on June 12, 1934, the date now set for the trial of the above case, and prior to the opening of said trial, or as soon thereafter as counsel can be heard, a motion will be made before the Sitting Judge of the United States District Court for the District of Maryland, at the Court Room, Federal Building, Baltimore, Maryland, to dismiss the Bill of Complaint herein in so far as it charges infringement of United States Letters Patent No. 1,455,141 and No. 1,635,117.

At the hearing of said motion reference will be made to the affidavit attached hereto.

We hand you herewith copies of the motion and affidavit referred to.

Very respectfully,

DARBY & DARBY,

Attorneys for Defendants.

Dated New York, N. Y.

May 29, 1934.

(Style of Court and Title Omitted.)

MOTION.

Now come the defendants in the above entitled cause and, on the pleadings and the annexed affidavit, move the court to dismiss the Bill of Complaint herein in so far as it charges infringement of United States Patent Nos. 1,455,141 and 1,635,117, owing to the fact that plaintiffs unreasonably neglected and delayed in filing a disclaimer under Title 35, United States Code, Sections 65 and 71, in respect of certain claims of said patents which

had been held invalid in a prior litigation against another defendant.

A. G. TRIPLETT, R. M. TRIPLETT,
A. NELSON, C. M. TRIPLETT, JR., and
THE BALTIMORE GASLIGHT COMPANY,
By DARBY & DARBY,
Attorneys.

Dated, May 29, 1934.

(Style of Court and Title Omitted.)

State of New York, County of New York, ss:

SAMUEL E. DARBY, JR., being first duly sworn, deposes and says as follows:

That he is a member of the firm of Darby & Darby, attorneys for the defendants in the above entitled cause, and is familiar with the issues involved therein.

That the litigation involves a suit in equity brought under the Patent Laws for the alleged infringement by the defendants of United States Letters Patent No. 1,455,141; No. 1,606,212, and No. 1,635,117, issued, respectively, on May 15, 1923, November 9, 1926, and July 5, 1927.

That in connection with the patents in suit and as the Bill of Complaint in paragraph 13 thereof alleges, the plaintiff, Dubilier Condenser Corporation, filed bills of complaint in the United States District Court for the District of Delaware on or about September 20, 1927, against the Radio Corporation of America charging infringement upon certain claims of said Letters Patent involved in the present suit. That on or about August 12, 1929, the said District Court for the District of Delaware entered its decree adjudging claims 3 and 14 of Letters Patent No. 1,455,141 to be valid and infringed, and adjudging claim 9 of said patent No. 1,635,117 to be valid and infringed. That thereafter the said defendant, Radio Corporation of America, perfected an appeal from the said decision to the United States Circuit Court of

Appeals for the Third Circuit, which court reversed the aforementioned decree of the District Court for the District of Delaware and held said claims invalid and directed the said bills of complaint to be dismissed. That the said decree of the District Court held the said patent No. 1,606,212 not to be infringed and no appeal was taken from said decree with respect to said patent No. 1,606,212. That a petition for rehearing was filed in the said Circuit Court of Appeals with respect to the decision of that court upon claim 9 of patent No. 1,635,117, which petition was denied. That thereafter plaintiff filed petitions in the Supreme Court of the United States for writs of certiorari to review said decisions of the Circuit Court of Appeals for the Third Circuit with respect to said patents Nos. 1,455,141 and 1,635,117, and the Supreme Court of the United States denied said petitions on or about October 25, 1932.

That on or about July 8, 1933, eight months and thirteen days after said petition for writ of certiorari was denied, the plaintiffs herein entered disclaimers in the United States Patent Office disclaiming portions of said Letters Patent which were stated to be too broad and which through inadvertence, accident or mistake, had been included in said patents.

That under the principles set forth in the opinion of the United States Supreme Court in Ensten v. Simon Ascher & Co., 282 U. S. 445, 455; 75 L. Ed. 453, illustrated by such decisions as R. Hoe & Company, Inc., et al. vs. Goss Printing Press Company, 31 Fed. (2d) 565, 566 (C. C. A. 2); Radio Condenser Company v. General Instrument Company, 65 F. (2d) 458, 459 (C. C. A. 2); Otis Elevator Company v. Pacific Finance Corporation, 68 Fed. (2d) 664, 670 (C. C. A. 9), and Better Packages, Inc., v. Nashua Package Sealing Company, Inc., decided by the United States District Court for the Southern District of New York (Woolsey, J.), on April 11, 1934 (not reported but copy of opinion attached hereto), it is contended that the plaintiffs herein unreasonably neglected and delayed in filing the disclaimers as alleged in the Bill of Complaint of said claims of patents Nos. 1,455,141 and 1,635,117 in suit, and therefore in view of the provisions of the Patent Laws of the United States, Title 35, United States Code, Sections 65 and 71, the pres-

ent suit cannot be maintained in so far as it is founded on the patents Nos. 1,455,141 and 1,635,117 mentioned, and to that extent must be dismissed.

SAMUEL E. DARBY, JR.

Sworn to and subscribed before
me this 29 day of May, 1934.

ROSE A. BATTERMAN,

Notary Public. (Seal.)

UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF NEW YORK.

Better Packages, Inc., Plaintiff,

vs.

Nashua Package Sealing Company, Inc., and Nashua Gummed and Coated Paper Company, Defendants.

OPINION
In Equity
No. 76/213

On motion to dismiss complaint in so far as it charges infringement of United States Patents Nos. 1,194,752 and 1,782,123, owing to the fact that the plaintiff as owner thereof had unreasonably neglected and delayed in filing a disclaimer under Title 35 United States Code, Sections 65 and 71, in respect of certain claims of those patents which had been held invalid in another litigation against another defendant.

Messrs. Emery, Booth, Varney & Whittemore, solicitors for defendants—by L. G. Miller, Esq., of counsel—in support of the motion.

Messrs. Hammond & Littell, solicitors for plaintiff—in opposition thereto.

WOOLSEY, J.:

The motion is in all respects granted.

1. The plaintiff did not avail itself of its right to appeal on or before November 2, 1932, from such part of the interlocutory decree of October 3, 1932, entered in

the case decided by Judge Coleman of Better Packages, Inc., against L. Link & Company, et al., 1 F. Supp. 132, as held invalid certain claims of patents No. 1,194,752 and No. 1,782,123.

I think that under the principles taught in the opinion of the Supreme Court in Ensten v. Simon Ascher & Co., 282 U. S. 445, 455, illustrated by such decisions as R. Hoe & Company, Inc., et al., v. Goss Printing Press Company, 31 F. (2d) 565, 566 (C. C. A. 2); Radio Condenser Company v. General Instrument Company, 65 F. (2d) 458, 459 (C. C. A. 2); and Otis Elevator Company v. Pacific Finance Corporation, 68 F. (2d) 664, 670 (C. C. A. 9), in order to maintain its right thereafter to sue for infringement of the claims of said patents which were held valid, the plaintiff should have filed its disclaimers in the circumstances here shown on or before December 2, 1932, that is, within thirty days at least after its time to appeal from the interlocutory decree of October 3, 1932, had expired, as it did on November 2, 1932. Title 28, United States Code, Sections 227 and 227a.

The plaintiff either should have justified its position as to these patents by securing, on appeal if it could, a reversal of Judge Coleman's ruling holding certain claims invalid, or by disclaimer it should have acquiesced in said ruling as the statute prescribes. For the ambit of a patent right must not be left vague, but must be kept clearly defined that the public may know its right in the face of the patentee's monopoly.

The plaintiff filed its disclaimer in respect of patent No. 1,194,752 on January 24, 1933. This was eighty-three days after the time to appeal from the interlocutory decree above mentioned had expired. In respect of patent No. 1,782,123, it has not filed any disclaimer, consequently, in view of the provisions of the Patent Law of the United States, Title 35, United States Code, Sections 65 and 71, the instant suit cannot be maintained in so far as it is founded on the patents mentioned, and to that extent must be dismissed.

Settle order on notice.

April 11, 1934.

* .....

United States District Judge.

* (Blank on copy attached to original Motion.)

PLAINTIFFS' ANSWERING AFFIDAVIT TO MOTION TO DISMISS.

Filed 13th June, 1934.

IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MARYLAND.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs,

vs.

A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and the Baltimore Gaslight Company, Defendants.

Equity No. 2193.

AFFIDAVIT OF PERCIVAL D. LOWELL AND FRANCIS W. DUNMORE.

State of Maryland, City of Baltimore, ss:

Percival D. Lowell and Francis W. Dunmore, being duly sworn, depose and say as follows:

We are plaintiffs in the above case and are joint inventors of United States Letters Patent No. 1455141 and 1606212, and the said Dunmore is the inventor of United States Patent No. 1635117, all of which patents are involved in the above case.

Shortly before the suit of the Dubilier Condenser Corporation against the Radio Corporation, involving the above patents, was tried before his Honor, Judge Morris, in the District of Delaware, interferences had been declared in the United States Patent Office by various claimants alleging prior inventorship with regard to the said patents as follows:

Michael I. Pupin, whose application for patent was owned by the Westinghouse Electric & Manufacturing Company; Robert D. Duncan, Jr., whose application was owned by Wired Radio, Inc., a subsidiary of the North American Company, and Albert S. Blatterman had filed

applications for patent, and all three of these applications were placed in interference with the above patent 1455141, the issue of the interference being claims 1, 2, 15, 16 and 18 of said Lowell and Dunmore patent 1445141, and the said interference being numbered 53154.

The said application of the said Robert D. Duncan, Jr. was also placed in interference with the said patent 1455141 and the issue of the said interference was claims 2, 20 and 21 of the said Lowell and Dunmore patent 1455141, the interference being numbered 53155.

The applications of the said Michael I. Pupin, and the said Albert S. Blatterman were also placed in interference with the said patent 1455141, the issue of the said interference being claims 2, 16 and 1 of the said Lowell and Dunmore patent 1455141, and the interference being numbered 51704.

The said application of Albert S. Blatterman was also placed in interference with the said patent 1455141 and the issue of the interference was claims 1, 2, 15, 18 and 19 of the said patent 1455141, the number of the interference being 51204.

During all of the time the said suit of the Dubilier Condenser Corporation against the Radio Corporation was being tried and heard on appeal, said interferences were proceeding. The contestants were financially able, and testimony was taken on behalf of the several parties. After the interferences were decided by the Patent Office tribunals in favor of Lowell and Dunmore, the said Blatterman filed a bill in equity under Section 4915 in the Supreme Court of the District of Columbia, seeking to review the decisions of the Patent Office and to have the invention in controversy awarded to said Blatterman. The said Wired Radio, Inc., and Robert D. Duncan, Jr., also filed a bill in equity in the Supreme Court of the District of Columbia against said Lowell and Dunmore, the said Blatterman and the said Westinghouse Electric & Manufacturing Company, also seeking to overthrow the decisions of the Patent Office, and seeking to have an award of priority made in favor of the said Duncan. These actions were pending and not disposed of until an order was made on October 23, 1933, dismissing the said suit of the said Blatterman, and order was made on

November 7, 1933, dismissing the said suit of the Wired Radio, Inc., and Robert D. Duncan, Jr.

The opinion of Judge Morris in the District Court for the District of Delaware, upholding patents 1455141 and 1635117, was filed on August 12, 1929. In April, 1930, the United States filed bills in equity against deponents, the Dubilier Condenser Corporation and the Morkrum Company, a licensee under the patents in suit, alleging in substance that the patents belonging to the United States and praying that a decree be entered adjudging that the United States is the owner of the said inventions; that the defendants hold the same as trustees for the benefit of the United States; that the defendants be directed to assign and convey to the United States all his or its right, title and interest in and to the said inventions; that the defendants be compelled "to account and to pay over to the plaintiff all monies received by him in connection with or arising out of the said invention and the said letters patent"; and that the plaintiff have such other and further relief as to the court may seem just, together with the costs of the action.

The suits against the affiant Percival D. Lowell were filed on April 19, 1930, in the United States District Court for the Eastern District of New York.

The suits against the affiant Francis W. Dunmore were filed at about the same time in the Supreme Court for the District of Columbia.

The suits against the Dubilier Condenser Corporation were filed in the District of Delaware on April 22, 1930.

The suits against the Morkrum Company were filed at about the same time in the District of Maine.

The suits against the Dubilier Condenser Corporation were tried before his Honor, Judge Nields, in the District of Delaware. After decision in favor of the defendants an appeal was taken by the Government to the Circuit Court of Appeals for the 3rd Circuit. These appeals were decided by the Circuit Court of Appeals for the 3rd Circuit some time after the filing of the opinions of that court with respect to the validity of patents 1455141 and 1635117. The decision of the Circuit Court of Appeals

being in favor of defendants, the Government applied for and was granted a petition for writ of certiorari and the case was heard by the Supreme Court at the October Term, 1932. On April 10, 1933, the Supreme Court by a divided court affirmed the opinion of the Circuit Court of Appeals and on May 8, 1933, amended the opinion.

We were advised by counsel that the decision of the Supreme Court did not prevent the Government from bringing to trial the suits brought against us as individuals and attempting to show facts other than those brought out in the Dubilier Condenser Corporation case, and further that counsel for the Department of Justice had stated that the matter of further proceedings was under consideration by the Department. However, on June 8, 1933, upon motion of the Government, the suits against the plaintiff-affiant Dunmore in the Supreme Court of the District of Columbia were dismissed by order of court, and on July 3, 1933, upon motion of counsel for the Government, the suits against the plaintiff-affiant Lowell in the Eastern District of New York were also dismissed.

We attach hereto in support of the foregoing allegations the following documents.

Exhibit A is a copy of the decisions of the Board of Appeals of the Patent Office, affirming the decisions of the Examiner of Interferences awarding priority of invention to affiants.

Exhibit B—Printed copies of the complaints and answers in the aforesaid suits of the United States against the Dubilier Condenser Corporation, Morkrum Company, Percival D. Lowell and Francis W. Dunmore, in which the Government sought to obtain title to the invention.

Exhibit C—Certified copy of the motions for dismissal and orders of dismissal in the Supreme Court for the District of Columbia in the aforesaid suits of United States vs. Francis W. Dunmore, Albert S. Blatterman vs. Percival D. Lowell and Francis W. Dunmore and Wired Radio, Inc., and Robert D. Duncan, Jr., vs. Percival D. Lowell, Francis W. Dunmore, Albert S. Blatterman and Westinghouse Electric & Manufacturing Company.

Exhibit D—Certified copy of motion and order of dismissal entered July 3, 1933, in the aforesaid suit of the

United States vs. Percival D. Lowell in the Eastern District of New York.

Exhibit E—Certified copy of motion for dismissal and order of dismissal of July 3, 1933, in the above mentioned suit of United States vs. Percival D. Lowell, No. 4935 in the Eastern District of New York.

Exhibit F—Copies of Bills of Complaint and Answers in the Blatterman and Wired Radio 4915 suits.

A short time after the decision of the Circuit Court of Appeals for the 3rd Circuit respecting the validity of claims 3 and 14 of the said patent 1455141 and claim 9 of the said patent 1635117 we inquired of counsel as to what steps could be taken toward reviewing the decision of the Circuit Court of Appeals. The cases having been consolidated for trial, a petition for certiorari was taken to the Supreme Court of the United States and denied. Thereafter the question arose as to proceedings in another jurisdiction. Counsel advised that any further proceedings should await the outcome of the interference proceedings, and especially await the outcome of the question of title then pending in the Supreme Court of the United States. The advisability of filing a disclaimer was also discussed. Counsel advised that in their opinion the opinion of the Circuit Court of Appeals respecting validity was based upon an interpretation of the claims which in their opinion did not represent the same thing or substantial equivalent of what was shown, described and claimed in the patent, and that the matter was largely, if not entirely, a matter of interpretation rather than disclaimer, since nothing in the prior right anticipated anything that would be disclaimed. After consideration it was decided that the placing on record of the disclaimers which were subsequently filed, would at least operate as a declaration of the patentees' interpretation of the patents, and would operate to prevent a broader construction of these claims than would be comprehended by what was shown and described or the equivalent thereof. Counsel also advised that should these disclaimers be filed before the dismissal of the suits by the Government, and should the Government obtain title to the patents, the Government might claim that the filing of such disclaimers operated to impair or destroy the usefulness of the patents, and in consequence might claim that affiants were liable in damages to the Government therefor.

In consequence of the foregoing advice it was deemed advisable to withhold the filing of the disclaimers, at least until the dismissal of the suits against your affiants Lowell and Dunmore. As above stated, this litigation against your affiants was ended by the dismissal of the suit against your affiant Lowell on July 3, 1933, and within a few days thereafter, i. e. on July 8, 1933, the disclaimers were filed.

PERCIVAL D. LOWELL,
FRANCIS W. DUNMORE,

Subscribed and sworn to this 13th day of June, 1934.

HELEN G. JAMES,
Notary Public.

(Seal)

MEMORANDUM.

Exhibits A, B, C, D, E and F attached to foregoing affidavit are here omitted and will be found in Volume II Book of Exhibits at pages 24, 48, 132, 144, 146 and 148, respectively.

AGREED STATEMENT OF EVIDENCE IN NARRATIVE FORM AND APPROVAL OF COURT.

Filed 12th December, 1934.

IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MARYLAND.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs, vs. A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, Defendants.	Equity No. 2193.

Baltimore, Maryland, June 13, 1934.

The above-entitled cause came on to be heard before his Honor Judge William C. Coleman on Wednesday, June 13, 1934, at 10:30 o'clock A. M.

Appearances:

Clifton V. Edwards, Esq. and John B. Brady, Esq. and Messrs. Semmes, Bowen & Semmes (by Gaylord Lee Clark, Esq.), on behalf of the plaintiffs.

Messrs. Darby & Darby (by Samuel E. Darby, Jr., Esq.) and Messrs. Cook & Markell (by Charles Markell, Esq.) on behalf of defendants.

The Court: I am sorry, gentlemen, I have kept you waiting, but this is the beginning of a new term, and I had to take up some matters with a new jury.

I would like to go ahead now, Mr. Clark.

Mr. Darby: If the Court please, I appear for the defendants; and by arrangement of counsel we are starting the trial with a motion to dismiss as to two of the patents. Should I proceed with the motion, your Honor?

The Court: Very well.

Mr. Darby: May I hand to the Court the motion papers and a brief memorandum of the law?

(Papers handed to the Court.)

Mr. Darby (Continuing): The facts necessary to be known by the Court on the matter of the motion are briefly these; This is a suit charging infringement of three patents, which, for convenience, I will call patents Nos. 1, 2 and 3. The patents have previously been in litigation; in the Third Circuit, three separate suits, one on each patent, were brought in the Delaware District Court before Judge Morris. As to Patent No. 1 and Patent No. 2, Judge Morris found the patents to be valid and infringed; as to Patent No. 3, Judge Morris found the patent to be not infringed; and his opinion, to which reference will be made later, indicates that he was of sufficient impression, if not to make his decision turn upon it, that the patent was invalid.

The plaintiffs, the owners of the patent, acquiesced in Judge Morris's ruling as to Patent No. 3, non-infringement. As to the other two patents, the unsuccessful defendant, the Radio Corporation of America, appealed to the Court of Appeals for the Third Circuit. The Court of Appeals, in the opinion by Judge Wooley, reversed

Judge Morris and held the patents Nos. 1 and 2 to be invalid. A rehearing was applied for and denied. Then a petition for Writ of Certiorari was filed in the Supreme Court and denied in October, 1932. The Patent owners waited for approximately eight and a half months thereafter to file a disclaimer for the invalid subject-matter—eight and a half months. Namely, on July 8, 1933.

Under the decision of the Ensten case, in the Supreme Court, in the Hoe case, in the Court of Appeals for the Second Circuit, and in a case which is reported in the current advance sheets of the Federal Supplement, the rule is under the Ensten case that the disclaimer, after all possible appeals have been exhausted, should be filed not later than thirty days to come within the disclaimer statutes as acting within a reasonable period of time. There are two decisions squarely on the point. And, therefore, we move to dismiss as to Patents Nos. 1 and 2, on the ground that the disclaimer has not been filed within a reasonable length of time, which is a condition precedent to a patent owner taking advantage of the remedial effect of the disclaimer statutes.

Mr. Edwards: If your Honor please, the disclaimer statutes do not fix any distinct period of time within which a disclaimer must be filed. The statute says that it must be filed within a reasonable time. And as stated in the Ensten case, which was quoted by your Honor in the recent case of the American Stainless Steel Company against the Rustless Iron Company, your Honor, quoting from the Ensten case, quoted this:

"The question of unreasonable delay is a question for the Court, upon the facts as found, either by its own investigation or the verdict of a jury. Delay begins whenever the patentee becomes aware that he has claimed more than he has invented or described."

Now, as to whether the patentees in this case have been guilty of any reasonable delay, there are several circumstances to be taken into consideration. I might mention, first, in the cases cited by Mr. Darby I do not think they go so far as to say that under the Ensten case, or any case, there is a fixed time limitation. In the Ensten case a suit had been brought and a decree entered, holding certain claims invalid, and no appeal was taken from that decision. The patentee waited some four years be-

fore filing a disclaimer of those invalid claims. In the Radio Condenser Company against the General Instrument Corporation, cited in Mr. Darby's motion, the suit was in the Southern District of New York on certain patents to a party named Cohen. The Patent Office had held an Interference contest, and decided that Cohen was not the inventor. No appeal was taken from that decision; and the parties waited about four years. And so the Court held that under those circumstances four years was an unreasonable delay.

In the case of Hoe against the Goss Printing Press Company, certain claims were for the first time held to be invalid by the Circuit Court of Appeals for the Second Circuit. Plaintiff wanted to proceed on certain other claims which were held to be valid. The Court of Appeals decided that its mandate should provide that unless plaintiff filed a petition for certiorari, that the decree would be that his bill would be dismissed unless he filed a disclaimer within thirty days. That may or may not have been harsh or unreasonable. But in that circuit that was the end of the litigation. The Circuit Court of Appeals decision there would become final, and so far as that Circuit was concerned nothing more could be done; and plaintiff, if it desired to proceed in that circuit, was naturally required to file a disclaimer. The plaintiff was not obliged to file a disclaimer. It could have proceeded elsewhere and waived its accounting.

The case referred to by Mr. Darby in Judge Woolsey's opinion is of the same character. In a suit in the District Court in the Southern District of New York, certain claims were held invalid, and no appeal was taken. Thereafter another suit was brought in the same court on the patent, and Judge Woolsey held that the delay of eighty-some odd days in that case in filing a disclaimer was unreasonable. Now, the facts are not at all clear in the opinion as to just why the Judge thought eighty-two days was an unreasonable delay; but the subject-matter of the patent obviously was of a very simple nature, so that the plaintiff would not have any difficulty in judging what its future course should be.

That there is no arbitrary limit is indicated by numerous decisions of the Supreme Court and others, one in the Mineral Separation case, where a delay of some three years was not considered unreasonable.

There was another one of these Stainless Steel cases, where, if I remember correctly, the disclaimer was filed some ten years after the granting of the patent, and was still held not to be unreasonable.

Another case in the Sixth Circuit, which went to the Supreme Court, was where the disclaimer had been held to be about four years, not unreasonable.

The Supreme Court, although invalidating the patents on other grounds, made no criticism of the matter of delay.

Now, in the case at Bar, the situation was not at all easy for the patentees to determine. In the first place, the subject-matter was quite difficult and complex. The claims of the patents in suit were directed broadly to means for eliminating hum in these alternating current operated radio sets. The plaintiffs were the inventors of the first radio receiving set to be operated from household alternating current. The invention has gone into very wide use. As I said, the claims were directed to a radio receiver, having a radio frequency portion, a detector portion, an amplifier portion means for eliminating hum in the several sections. Well, now, the specification and claims show very definite means for eliminating hum. We contended in the Third Circuit that the three claims of the patents there involved should be construed to mean, under established rules, that the word "means" means the same thing, or the equivalent of what was shown in the patent. Judge Wooley in his opinion read the claims literally, and said that you have hum eliminating means in the three sections, and I do not see when you separate them but what they operate in the same way, and, therefore, I think the claims constitute a mere aggregation and not a patentable invention. There was no anticipation of the claims, and the Court did not hold that any of the claims were anticipated. It was purely a matter of so construing the claims, the word "means", as to include any kind of means, and then held that in the view of the Court the claims were for an aggregation.

In the lower Court Judge Morris had taken the opposite view, and had construed the claims with reference to what was shown in the patent, and had found the patents to be valid and infringed.

Now, strictly speaking, I did not think, and I do not think now that any disclaimer actually was necessary. The disclaimers in these cases do not disclaim the claims which were held invalid. They do not disclaim claims 3, 14 and 9, for example. Nothing in those disclaimers would avoid any prior art that would otherwise anticipate; they merely place on record the patentees' declaration of their understanding of what the word "means" does mean. And in that sense I thought, and I still think, that it is a debatable question whether any disclaimer actually is necessary at all or not; but by way of precaution it was finally deemed desirable to file those disclaimers.

Now, as to why they were not fied earlier, there were other reasons in addition to the complexity of the subject-matter. One was that shortly before the trial in the District Court, the Patent Office instituted four different interference proceedings with the main patent in suit. One of these contestants was Professor Pupin, whose invention was owned by the Westinghouse Electric & Manufacturing Company. Another one was by Mr. Duncan, whose invention was owned by Wired Radio, a subsidiary of a large company; another by a man named Blatterman; and another by an inventor whose invention was owned by the Hazletine Company. Those interferences continued throughout all the time the suits were pending. And after the decisions in the Patent Office the plaintiffs filed bills under Section 4915 in the Supreme Court of the District of Columbia; and those cases were not terminated until about October of 1933, after the filing of the disclaimer.

Then, worse than all, immediately—not immediately, but after Judge Morris filed his opinion upholding the patents, which was about August, 1929, the Government filed bills of complaint in April of 1930, one against the Inventor Lowell in the Eastern District of New York and in the District of Columbia against the inventor Dunmore; another in the District of Delaware against the Dubilier Condenser Company, the exclusive licensee; and another in the District of Maine against another licensee. The Government alleged that the title to the patents belonged to the Government; and in their prayers they asked that the defendants be decreed to be holding the patents as trustees for

the Government, and that they be required to account and pay over to the Government any properties, damages or moneys received of any nature by reason of the holding of the title of the patents by the defendant.

That case went to trial in the District of Delaware, and was decided before the cases were decided in the Circuit Court of Appeals. The decision in the District Court was in favor of the patentees, the plaintiffs here, and the Government took an appeal to the Circuit Court of Appeals of the Third Circuit. That Court affirmed the lower court in a decision filed some time after the decision regarding the validity and infringement.

Thereupon, the Government petitioned for and was granted a Writ of Certiorari, certifying the cases to the Supreme Court. The Supreme Court, by a divided court, decided the cases on April 10, 1933. On May 3rd they revised the opinion by striking out a certain portion. There was a period during which the Government had indicated that it intended to retry the questions in the suits against the individual defendants. The suit that went to the Supreme Court was only the suit against the Dubilier Condenser Company, and not the suit against the individual defendants. Well, finally, the Government decided not to press those suits. One of them was dismissed in June of 1933, and the other, the last one, against Mr. Lowell, was dismissed on July 3, 1933; and these disclaimers were filed on July 8, 1933.

Now, during that period, if these plaintiffs had filed disclaimers, and if the decision in the Supreme Court had gone against them, they were liable to be called to account to the Government for either damaging or destroying the property of the Government by reason of the disclaimers. And, therefore, in view of all the circumstances, we respectfully submit that if any disclaimer is necessary at all with respect to these two patents, that the plaintiffs were amply justified in waiting for the period that they did after the decisions of the Supreme Court, to wait for the dismissal. The Supreme Court decisions, as I say, were April 10, 1933, a period of about four months; and the actual decision was July 3rd; and up to that time these plaintiffs were in an uncertain state, first, as to whether anything was required or not, and second, whether these other inventors would be held to be

prior in date, and third, whether the Government would take the title away, and if it did take the title away, whether it would call them to account for any actions done in the meantime. I respectfully submit that under all the circumstances that was a very reasonable delay, even if any disclaimer is required.

I also suggest—and the disclaimer applies to only patents—the facts, the subject matter of the patents, the character of the patents also bears very largely on the question of whether there was an undue delay, and since we have one patent to proceed with anyway, that the proper procedure would be to allow the plaintiffs to make their record and let this question stand over until the whole record is before your Honor, in view of all the circumstances, to decide whether a disclaimer should have been filed or not, and if so, whether there was any unusual delay. That practice is what I think is the usual practice, as I gather from the various records.

I will file an affidavit of the two patentees, setting forth the circumstances that I have just related, and also a memorandum regarding the cases.

The Court: I am not quite sure that I followed all the facts. I would like to ask you to rehearse that again. Now, as I understand it, as set forth by Mr. Darby, both in his statement and in his brief, the Circuit Court of Appeals for the Third Circuit declared the two claims invalid in the two patents, and then in the Supreme Court a review was denied in October, 1932. Now, I did not quite follow everything you said in regard to the other litigation.

Mr. Edwards: Now, in October, 1932, there were still pending four interference contests, as represented by bills of complaint filed in the District of Columbia to review the proceeding of the Patent Office, in which these adverse claimants alleged that they were entitled to the patent. There was also pending before the Supreme Court the record awaiting argument in the suit of the Government against the Dubilier Condenser Company, which bill had been filed in Delaware. The cases against Lowell, Dunmore and the Morkrum Company in Maine were standing by without trial. That was the situation in October. The plaintiffs at that time considered the matter of further procedure. Obviously there was no

use proceeding in the Third Circuit, because that Court of Appeals had expressed its view. Naturally we preferred to exercise our right to go to another jurisdiction to make up our record and to submit the whole case to the Supreme Court, or the final court, on the record, not only with regard to these claims, but the other claims of the patents, which had not been in issue in that controversy.

Now, as to whether that disclaimer was to be filed, that, as I say, invited some controversy and some argument; but that continued until the decision of the Supreme Court in April—April 10, 1933. Now, at the time of that decision, the bills of complaint under Section 4915, by these rival inventors, were still pending in the Supreme Court of the District of Columbia. Also the bills of complaint by the Government against the individual defendants Dunmore, Lowell and the Morkrum Company were still undisposed of; and for a period of about a month the Department of Justice indicated that it proposed to bring on for trial one or the other of those suits, preferably the one against Dunmore, in the District of Columbia, in order to make a proper record for the Government. That occupied a period of nearly a month. In June the Government indicated that it would not contest the title; and then in the latter part of June dismissed the suit against Dunmore; and July 3rd dismissed the suit against Lowell. And by that time the question of title was reasonably safe, for it had been disposed of; and then for the first time the plaintiffs were in a position where they could file a disclaimer without subjecting themselves to possible suit for damages or claim for damages in accounting proceedings by the Government. After that these rival claimants, considering that the matter was more or less hopeless, gave up, and they dismissed their suit.

The Court: I do not quite see what that has got to do directly with the question in this case. It is rather involved, but I do not quite follow you. The time may not have been too long; but what has that got to do with the attempt to disclaim after the Third Circuit had gotten through with the matter, and why go further?

Mr. Edwards: Well, we could go further, your Honor. We were not bound by that decision in the Third Circuit

Court of Appeals. We had a perfect right to go further in another jurisdiction; and nothing in the Ensten case——

The Court: That is true.

Mr. Edwards: —or any of the others required us to accept that decision. Nothing barred us from going elsewhere. Had we desired to go further, I quite agree that we would have been obliged to make our election very quickly, very promptly; and whether eighty days would have been unreasonable or not, in view of the subject matter, and in view of the questionable title, and so forth, would, I think, have been for the Court to decide whether the delay was unreasonable.

Now, here we are not in the Third Circuit; we are here in another jurisdiction. We meet at the outset the very question of whether any disclaimer is necessary at all. If no disclaimer is necessary, the situation is precisely as that said by the Supreme Court in the Carnegie Steel Company, namely, that the disclaimer can do no harm. A disclaimer is necessary only where some one has claimed more than he is entitled to. Now, no art anticipated these claims. No Court decision has held that these claims were anticipated. The Court in the Third Circuit, the Court of Appeals did express its opinion to the effect that the claims amounted to no more than aggregation.

But not desiring to accept that as final, we next contemplated proceeding elsewhere. If we were required to file a disclaimer, then comes up the question of unreasonable delay. And I respectfully submit that a delay of 82 days, in the face of the difficult subject-matter, and an impending series of suits by the United States to acquire title to the patent was ample justification for the plaintiffs to wait that length of time before they actually filed these disclaimers. Just as soon as the title was cleared up they did file the disclaimers, within five days.

The Court: Can the matter be heard satisfactorily by proceeding with the one patent that is not involved in this bill for dismissal, and then reserving the question as to the others?

Mr. Edwards: Well, if we do that, it will be done, I think, in a very unsatisfactory way.

The Court: Well, I did not mean not to hear it, but could I reserve my decision on this question and proceed with satisfaction to both parties in developing the proof as to the third patent, and then deciding the other question after this procedure?

Mr. Edwards: It would be just about as easy to develop all of the proofs at once. These three patents all relate to the same general subject matter; namely, how to make a radio receiving apparatus which will operate on alternating current such as we have in lighting circuits, household lighting circuits. The first patent is the broad patent.

The Court: Now, when you say the first, you mean one of the two that were involved in the suit in the Third Circuit?

Mr. Edwards: Yes. Now, the decision in the other litigation involved two claims of that patent. Here there are six or eight other claims in issue. In showing the history of the other two inventions, it is what the patentees did with regard to the first two inventions. Therefore, when they show the later invention, they really show all of them all at once. And if I may suggest, it would seem to be, as a practical matter, that we could easily put in our proofs on all three patents just about as quickly as one, and then the whole matter could be determined in the light of the facts as they appear.

The Court: Mr. Darby, have you anything else to say?

Mr. Darby: Your Honor, may I say just a few words in reply? I first suggest that this question of litigation involving the title of the patent has nothing whatsoever to do with the question of disclaimer. The one who professes title and who has title is the one who is charged with the responsibility of taking advantage of the Disclaimer Statute, if it is to be taken advantage of. Likewise, Mr. Edwards made reference to a pending interference in which the patent was involved. That interference involved only one of the patents, not both of them; and it did not involve any of the claims of that patent which had been held to be invalid. Now, the law is very clearly established that one to take advantage of the benefits of the disclaimer statute to disclaim what has been held to

be invalid—and it is immaterial whether that invalidity is because of anticipation, aggregation or of something else—is charged with the responsibility of doing it within a reasonable length of time, promptly, after it has been called to his attention, the patent owner's attention, that his patent contains more than he is entitled to. Now, that was called, under the authorities, expressly to the attention of the plaintiff in this case who has title, and this claim to title had never been disturbed when the Supreme Court denied the petition for writ of certiorari; and there is no excuse, and there can be no excuse for their delaying to file disclaimer for eight and a half months thereafter.

The Court of Appeals in the Second Circuit in the Hoe case—and Mr. Markell calls my attention to page 8 of my memorandum, that it is incorrectly cited, and it should be 31 Fed. 2nd instead of 31 Fed.—the Court of Appeals there set a maximum of thirty days after the denial by the Supreme Court of an application for writ of certiorari. Here the plaintiffs waited eight and a half months.

This current decision of Judge Woolsey in the Southern District of New York in the Better Package case is now reported in the Federal Supplement. It was not at the time the motion was brought, and plaintiff was served; and, therefore, your Honor will find a copy attached to the moving papers.

Likewise it adheres to the position that thirty days is the limit of time within which action must be taken. And when Mr. Edwards makes the amazing statement that he is not sure whether they need a disclaimer raises another point, it is tantamount to the admission that there was no disclaimer, was no adequate disclaimer disclaiming these invalid claims, which alone invalidates the patent under the law. It is, of course, quite obvious that if we are to go to trial on three patents, two of which are under the authorities of the Supreme Court, invalid, it is going to consume considerably more time than if we go to trial on one patent; but I gather from Mr. Edwards' argument that he predicates his hope to succeed on this motion on the proposition that he had another alternative; namely, he could file a suit in another jurisdiction on the same patent, even on those invalid claims, without a

disclaimer. That is not the fact. That is the very proposition that has been presented in each one of these decisions which pass on the question of a reasonable time within which to file a disclaimer, because that is one that logically suggests itself to the advocate: Have I exceeded my reasonable time if I can sue somebody else? In one of these cases they had actually sued somebody else in another jurisdiction. There is a suit pending. And the courts say that is no excuse.

The Court: Which case is that?

Mr. Darby: I think it is the Hoe case.

The Court: Which case?

Mr. Darby: The Hoe case. But that same argument is presented in almost every one of them. I know it was an argument that was presented in the Better Package cases. But Judge Woolsey does not refer to it.

In the Hoe case in 31 Fed. 2nd, 565, and in the Radio Condenser case, I think it is alleged in an argument that is there made, and I know it likewise is an argument that was made in the Otis Elevator case, decided by Judge Mack, who was sitting in the Court of Appeals for the Ninth Circuit at the time he rendered the decision in that case. So that same contention has been made every time this question has been raised. In other words, if I accept Mr. Edwards' contention, he is coming to this Court, inviting this Court to disagree with the Court of Appeals of the Third Circuit on identically the same subject matter, the same claims that were held to be there invalid.

Now, it is true that there are additional claims in this case which were not before the Court of Appeals; but they are all directed to the same subject matter.

Likewise, the reason why I told your Honor that our side of the case would not take over an hour is because of the fact that we have stipulated that the record before the Court of Appeals in the Third Circuit, or the record before the District Court, as reduced to narrative form for the Court of Appeals in the Third Circuit, shall constitute the record here; so that Mr. Edwards is free to adduce additional testimony in addition to that record if he wants to; but his whole case boils down to the propo-

sition of asking this Court, or inviting this Court, to disagree with the Court of Appeals in the Third Circuit on that same record. And, of course, if it would be simplified by eliminating two major patents, why, we inevitably save an enormous amount of time.

Mr. Edwards: May it please your Honor, there is an element in all of the cases referred to by Mr. Darby that is not present here, and that is, in all of these cases the patentee had either failed to take an appeal, and thereafter waited a long time, or they were cases like the Hoe case and this Better Package case, where the plaintiff desired to proceed in the same jurisdiction.

Now, in the Hoe case the Circuit Court of Appeals there merely said, If you want to proceed further in this District you must file a disclaimer here within thirty days. The plaintiff was not obliged to file that disclaimer.

Now, in the Better Packages case the plaintiff had failed to take appeal, thereby accepting it as final. Now, in the case at bar there never was such an acceptance by these patentees. There never was a period of time during which they became aware in the sense of the statute that is recognized, that they had claimed too much. Are they to be shut off from showing, not as Mr. Darby suggests, upon this same record—we merely stipulate that either party may use any part of the record in the earlier case here—but we propose to show here that Judge Woolley was entirely wrong in saying that the action of the hum-eliminating means in each of the three parts of the instrument is the same. We propose to show and demonstrate that there is an actual cooperative combination, and that in the second patent that Judge Woolley was wrong in assuming that those filters delivered one hundred per cent pure direct current to the tubes. Are these inventors who made what, I submit, is one of the really great inventions in the radio art, to be deprived of their right to show the facts, to bring out the facts, merely because for a period of eighty-two days, during a period of uncertainty, during a period when the title was still clouded, and where if they filed anything, they were in all probabilities subjecting themselves to penalties—is that to be a technical excuse for depriving them of their right to show a real invention? I respectfully submit

that nothing in this case justifies any holding of unreasonable delay, and nothing in any of the other cases fixes any thirty days' limit as the time. It is the statute that covers it; and the statute says reasonable delay; and the Supreme Court in the Ensten case says that is to be determined upon all the facts in the case.

The Court: I would like to stop here to read the Ensten case again, gentlemen.

(Case read by the Court).

Mr. Darby: May I ask your Honor on this point that Mr. Edwards raised of the proposition arising in the same Circuit where the invalidation occurred? I call your Honor's attention to the Ensten case. The invalidation occurred in Ohio, but the decision was rendered in a case where the certiorari was directed to the Court of Appeals of the Second Circuit. In the Radio Condenser case the patent was issued and the claim was held invalid in an interference proceeding in the Patent Office, and nevertheless the rule applied; and on this contention that they have the right to sue in different circuits, may I read or ask your Honor to read the per curiam opinion. Would you rather have me read it?

The Court: Go ahead.

Mr. Darby: It is the per curiam opinion of the Court of Appeals in the Hoe case.

"The plaintiff at bar goes further, however, arguing that, even after denial of an application for certiorari, the patentee should not be obliged to disclaim. It argues that the Circuit Court of Appeals of another circuit might disagree with our ruling, and the Supreme Court would then take the case on certiorari and might declare the claims valid. A disclaimer would merely destroy this right, though the defendant is protected forever by its decree, and really has no interest in the disclaimer at all. While we acknowledge the difficulty and the possibility, it appears to us that so to extend the patentee's time might result in avoiding the statute altogether. The patentee may not sue again, or, if he does, the result may not be the same. It does not follow because two Circuit Courts of Appeal have held the same way, that a third will not disagree. Must the patentee disclaim at the conclusion of the second suit, or may he wait until all nine

Circuits have passed upon his claims? The question is at best of seasonable action, and in practice there must be some end, short of exhausting all conceivable remedies. When the patent has once passed through all the courts then available, the statute should have its effect; else the putatively invalid claims may remain as scarecrows, preserved against the bare possibility that at some future time they may come to life.

"The mandate will therefore be recalled and amended, so as to require the plaintiff to file a disclaimer within thirty days after the time expires within which to petition for certiorari or, if it does so petition, then within thirty days after denial, if it is denied, or affirmance of the decree, if it is granted, and the decree is affirmed."

The Court: Which case is that?

Mr. Darby: That is the Hoe case, Hoe vs. Goss Printing Press Company, by the Circuit Court of Appeals for the Second Circuit, in a per curiam opinion.

The Court: Let me see that.

(Handed to the Court.)

Mr. Darby: What I read to your Honor was under paragraph marked 2.

Mr. Edwards: May I say, your Honor, with regard to the Hoe case, that I submit that that does not have any bearing here, because that related only to the question of how far a Court of Appeals would permit a patentee to delay before filing a disclaimer and proceeding in that circuit. Nothing in that opinion prevented the plaintiff from proceeding in another circuit, to contest the ruling of the Second Circuit. The Second Circuit Court of Appeals merely declined to let action stay indefinitely to allow the plaintiff to contest his patent in other jurisdictions.

And may I also suggest, that all that Mr. Darby's motion comes to is the question of whether or not we must accept the ruling of the Circuit Court of Appeals within thirty days, or whether we have the right to proceed elsewhere. Have we the right to bring a suit on these patents in another jurisdiction if we delay more than thirty days, regardless of whether we find a defendant who is

infringing or against whom we can bring a case. His whole argument, I submit, is addressed to the point that there is a fixed time, say a thirty day limit, within which a plaintiff must proceed if he wants to proceed in another jurisdiction; and the whole effort here is merely to force the plaintiff to accept the decision of the Third Circuit and to cut the plaintiff off from proceeding in another circuit.

The Court: After examining the authorities and briefs, I am disposed to find that there has not been an unreasonable delay in the disclaimers. Of course, that is always a question of fact, and it is possible to read a number of cases and take their language in whole cloth in making them prima facie fit the facts, in the case before us. It seems to me that a reasonable interpretation of the law, and what the Supreme Court has said in construing the law, should lead to the conclusion that the plaintiffs should be allowed to go ahead at this time with respect to all three of the patents.

This suit, as I understand it, was filed on August 17th, 1933. Now, it was some time prior to that, as I understand it, that these disclaimers were on file in the Patent Office, that is correct?

Mr. Darby: In July.

The Court: In July. And, after all, there can not be any rigid rule. The Court in other Circuits, speaking about the effect upon the public, pointed out in the case which you just cited, Mr. Darby: "When the patent has once passed through all the courts then available, the statute should have its effect; else the putatively invalid claims may remain as scarecrows, preserved against the bare possibility that at some future time they may come to life." (Quoting from the case of the Hoe Company vs. Goss Printing Press Co., 31 Fed. 2nd, 565).

But it seems to me that unless there has been an unusually long delay—and it has been less than nine months —it does not seem to me to be—what was the exact amount of time in this case?

Mr. Darby: Eight months and thirteen days.

The Court: Eight months and thirteen days. That does not seem to me to be unreasonable under the circumstances, where the statute does not prescribe any time.

The Supreme Court in the Ensten case said on page 455:

"When a competent court has declared his pretentions without sufficient foundation, we think good faith and the spirit of the enactment demand that he act with such promptness as the circumstances permit, either to vindicate his position or to relieve the public from further evil effects of his false assertion. But for the benign provisions of the statute, such an assertion would invalidate the whole patent; and these provisions were intended to protect only those who by prompt action either seek to overturn an adverse ruling or retreat from a false position."

It seems to me in these cases that we are really more concerned with whether there has been any effect upon the defendant before us, which is unfair, rather than the possibility of the public, speaking broadly, being affected by a delay which might be a little bit unreasonable; but for aught that appears, a case of this kind ought not to have any effect upon anybody, but possibly on the litigants themselves.

Now, the disclaimers were admittedly properly filed before this suit, and there is no irregularity. I am not impressed, in other words, with an argument in a case of this kind that any deception has been caused the public. I think that is too broad a statement. And unless the statute says you have got to disclaim within a given time, the leeway left to the Court ought to be construed in every case rather liberally in the absence of proof of some untoward result flowing from the delay. Now, there is nothing in this case to indicate that anybody has been affected adversely by what has happened. Certainly the defendants in the present case have not been. Everybody concerned certainly knows all about the situation; and plaintiffs became affected at the time, so as not in any way to injure the present parties. So I think it is more of an abstract case of possible delay rather than a case of concrete injustice growing out of this argument of defendant; and I am rather impressed with the

reasons given for that delay, although when you stop to analyze them they may not fit within the interpretation given the statute by the numerous cases to which I have been referred. So that is my present inclination.

If you have anything further to say on the point, Mr. Darby, I will be glad to hear you.

Mr. Darby: Merely this: I regret that I did not also ask your Honor to read the Otis Elevator case, which covers the point which apparently impresses your Honor.

The Court: Well, I will be glad to read it.

Mr. Darby: That is the Court of Appeals of the Ninth Circuit.

The Court: Have you got it there?

Mr. Darby: No, it is cited in the brief.

I might say this: Here was the situation there: It was a patent infringement suit by the Otis Elevator Company against the Atlantic Elevator Company, I think it was, on the Pacific Coast. The matter was referred to a Special Master. The Special Master found eight of the ten claims of the patent to be valid and infringed. One claim he found to be invalid because of aggregation. The plaintiff took no exception to the holding of the Special Master that this claim was invalid, and went through the accounting proceeding; and the defendant in that case, where it was purely a technical matter—I think the whole subject is extremely technical, and I do not think that the question of fraud or imposition is a matter which any of the courts have gone into. I think they have taken rather the attitude that this is a remedy that can be availed of by a patentee that has had some part of his patent held to be invalid only if he acts promptly; and the reason is that he is in the position to hold people in the interregnum, but whether or not he does is not a matter of proof, or with which the courts have thus far been concerned.

The Court: But that ought to have some bearing upon the liberality or lack of liberality with which the given court would approach the matter, ought it not?

Mr. Darby: I do not know, if your Honor please. Of course, we are all entitled to different viewpoints on a

technical subject of this nature, and my own personal thought, for what it may be worth, is this, that great criticism has been directed to the judicial system on the law in connection with patents making it possible for a party to be unsuccessful in one circuit, and then going to another circuit and then retrying the thing all over again; and I have more or less hailed the decision of the Supreme Court in the Ensten case as a step in the direction of giving a patent owner a chance to try out his patent once; and he can get in another circuit only if he is successful. That may be a very far-fetched theory, but nevertheless, that is the one that I think has been evolved as a result of the Ensten case. He can not go to another circuit and retry the same subject-matter unless he is successful. I may be a hundred per cent wrong, but that is my guess as to what was behind the reasoning in the Ensten case, because——

The Court: Granting that to be sound, I do not think the Ensten case would compel the Court to agree with you because there was a different type of delay and very much longer delay.

Mr. Darby: Much longer delay; and all the Court held there in so far as the question of time was concerned is that it must be within a reasonable length of time, holding that the particular length of time before it was unreasonable, leaving for the other courts to decide, as I view it, what constitutes a reasonable length of time.

In the Otis Elevator Company case the time of the delay there was about a year. In the few cases in New York the Court has fixed the time as thirty days from the decision of the Supreme Court. I am frank to confess that those are the only authorities that I have got. Those are the only authorities I am able to find. They pointed the way rather clearly to me to present the motion to the Court. And as I understand it, the Court has overruled my motion to dismiss at this point and if your Honor will allow me an exception, for the sake of the record?

The Court: Yes.

Mr. Darby: I will next offer a stipulation and order permitting the defendant to amend its answer by the inclusion of a paragraph, raising as a defense to the suit

invalidity of the patent by reason of unreasonable delay in filing the disclaimer, as well as the inadequacy of the disclaimer.

(Paper handed to the Court).

The Court: You do not care to be heard on that?

Mr. Edwards: No, there will be no objection to that.

The Court: Very well, I will allow that to be filed.

Well, gentlemen, we can proceed, and adjourn at one o'clock, if you want to start with your statement of facts.

OPENING STATEMENT ON BEHALF OF PLAINTIFFS.

Mr. Edwards: I have here, your Honor, loose copies of the three patents in suit, which may be of some convenience. All three patents relate, as I stated before, to the operation of radio receiving apparatus through household alternating current.

The subject of wireless telegraphy is of comparatively recent origin. Most of us can remember as matters of public knowledge that our present day broadcasting stations came into being about 1921. I believe it is generally considered that the first commercial broadcasting station was the KDKA Station at Pittsburgh, which was opened in the fall of 1921. During 1919, 1920 and 1921, and the years following the war, we had many amateurs, using what we called crystal detector sets. Then, when the broadcast stations opened the demand for receiving sets, standardized the sets, and brought in the necessity for manufacturers making sets which would be sold on the market, to be used.

In the meantime, following the war, the amateurs and others began using vacuum tubes. By that we mean the three electrode vacuum tube, the invention of Dr. Lee De Forest, which was recently sustained by the Supreme Court. And I think there will be little dispute among us that that invention has made more changes and established more new industries than anything that we have had within the past twenty-five to thirty years or more. It enabled us to amplify a small energy into a large energy. More specifically, if we receive a very small or infinitesimal energy upon the grid of the tube, that grid

will control a local circuit, which may be one of very large power; in short, that is a distortionless relay.

The Court: Now, you are talking in technical terms. I have no doubt but that is correct, but I wish you would sort of get down to earth a little more and talk in layman's terms, and then I believe I could follow you better. Let us assume that I know nothing about this problem at all.

Mr. Edwards: Now, at this stage I do not think it is necessary for me to say more than that when these sets of which I speak, using these vacuum tubes, came upon the market, we used batteries to furnish the current for the tubes. You will hear of A batteries for lighting the filament, and B batteries for furnishing current to the plate, and a filament battery for furnishing current to the filament, that current being furnished, as I say, by the batteries, which was a steady current.

The current which we have in our lighting circuits is of the alternating current, that is, it first increases in strength to a maximum in one direction and then recedes to zero, and then goes down to a maximum value in the opposite direction, and comes back to zero, and goes up and down, and so on. If you put that type of current upon these tubes you got into difficulties, by making a humming noise, which was much louder than the signal.

Now, what I propose to do, with your Honor's consent, when we open this afternoon, is to put on a motion picture film of the General Electric Company, of its Educational Department, which illustrates the underlying principles of the transmitting station and the receiving stations. The film does not show the features here in controversy, but it is the starting point, so to speak, where we begin with the inventions of the patents in suit.

These films show this three electrode tube, or illustrate the circuits, and the putting of the electricity upon these circuits, so that we can to some extent visualize what the tube is, how it works; and so we will then understand what the witnesses talk about when they are talking about the filament circuit and the grid circuit and the plate circuit and the A batteries and the B batteries and the C batteries. And it is a non-controversial film. I understand Mr. Darby will not object to it, because it will save

considerable argument on my part, and will, as I say, merely give us a starting point. If Your Honor has no objection, we will just run this film off over in the corner. The two of them take nearly half an hour. There is some matter in them that could be left out, which has no particular bearing here, but I think it would be somewhat instructive in enabling us to visualize the situation as a starting point.

From there on we propose to show to your Honor just what sets were on the market, what the effect of alternating current on these sets would have been, and then show by demonstration here by the patented apparatus and the features introduced by these patentees, which result in receiving this faint signal circuit, putting it into an instrument which is receiving a substantial alternating power current, and yet getting out of the instrument a pure signal current, undistorted, and carrying the original speech or music without disintegration or destruction. And perhaps if this is the convenient time for us to adjourn, we might start with that immediately after lunch.

The Court: Very well, sir.

Now, let me have some information as to the patents. How many claims now are involved in this suit?

Mr. Edwards: I will give you a list of the claims, which I should have marked on the patents. But in the first patent, in Patent No. 1,455,141—your Honor has that before you?

The Court: Yes.

Mr. Edwards: You might mark claims 1 to 4 and claims 13 and 14.

In the Dunmore Patent No. 1,635,117——

The Court: Now, just a moment. I thought 14 had been passed on by the Circuit Court of Appeals.

Mr. Edwards: That is correct, sir. 1,455,141 is one, and in that case claims 3 and 14 were passed upon by the Circuit Court of Appeals and Judge Morris.

The Court: And 3 and 14 are the ones that the disclaimers are involved with here?

Mr. Edwards: Correct.

The Court: What claims are you considering now?

Mr. Edwards: We are not considering claims 1 to 4, 13 and 14.

The Court: It seems pertinent to ask here, why is this litigation all split up? Why could not the patent attorneys and client relieve the Federal Courts all around by not bringing these separate suits? Why, when asserting these claims before the Court in Philadelphia, why could they not all have been tried there?

Mr. Edwards: I might explain the circumstances, why it happened.

The Court: That situation does not appeal to me. I have had some practice in that, and I do not look with favor upon it.

Mr. Edwards: In an ordinary case I think we would all agree with your Honor. The reason that that happened in this case was because at about the time the suit was brought against the Radio Corporation on this patent there were four large contestants who brought interferences in the Patent Office, which involved practically all of these claims and others. We were confronted with long, expensive contests in the Patent Office; had we insisted on trying out the claims involved in those interferences, we would have had a trial that would have occupied months, because each of those claimants would have insisted on proving his date of invention. The case having been started, it was then deemed advisable to try in that case claims 3 and 14, which were not involved in any of the interferences, and thereby it became possible to present to the Court an issue as to the claims which did not involve the question of priority as to these other inventors. And that is the reason that these other claims have come in. Since that time all of the interference contests have been disposed of, and now we bring in the broader claims which are broader than the claims in issue in the Third Circuit.

Mr. Darby: Could I add to Mr. Edwards' statement my viewpoint on that?

The Court: What do you say?

Mr. Darby: Could I add to Mr. Edwards' statement my answer to your question?

The Court: Yes.

Mr. Darby: These additional claims are directed exactly to the same subject matter, the same invention as the claims which were before the Court of Appeals before. They add nothing new. So far as we are concerned, I have always viewed the fact that additional claims where added at all was because they would have something left over, and in addition to, on their face at least, what was declared to be invalid by the Court of Appeals, and it is directed to the same invention, the same subject matter, in just slightly varying language. I likewise call your Honor's attention to the fact that the disclaimer which was filed in connection with the patent was filed in connection with each of the claims that are here in suit. In other words, the disclaimer was not limited to claims 3 and 14, which were held invalid by the Court of Appeals, but the disclaimer was filed as to each of the claims which are now declared upon, namely, 1 to 4, and 13 to 14.

Mr. Edwards: For the same reason that we desired to put on the record our declaration of our interpretation of those claims, beyond which we do not want to go. As to the claims being the same thing, I think it will appear as we proceed that the claims are not for the same thing. Claims 3 and 14 were limited specifically to separate hum-eliminating means in the respective parts of the instrument. That is a separate and separable part of the invention. And the other claims are not so limited, but are broad enough to include these means, whether they be in separated parts or not, a very substantial difference, I submit, as will be shown later on.

Mr. Darby: Will it be of assistance to your Honor, although I have given the citations of the Court of Appeals decisions—would it be of assistance to your Honor to have loose-leaf copies of the Court of Appeals decisions?

The Court: Very well.

(Papers handed to the Court.)

Mr. Darby: From which you will find that the Court goes into the subject-matter rather than claims.

The Court: Well, are you arguing now, Mr. Darby, that this Court ought not to consider the matter at all?

Mr. Darby: Oh, no, sir.

The Court: At this time?

Mr. Darby: I understand that is past. That was the question of my motion. But I understand the Court has overruled my motion, and will go into the merits.

The Court: No, I mean to consider it on other grounds. Maybe you have some other grounds?

Mr. Darby: No. You have disposed of my motion adversely to my contention, and I see no escape but for the Court to go into the merits and determine whether or not it will disagree with the Court of Appeals for the Third Circuit on the same evidence. And I anticipate that Mr. Edwards will, at the conclusion of his statement of his case, and prior to the offering of evidence, give me an opportunity, if the Court desires it, to have me expressly outline my position in the case, in the hope that it might narrow the issues.

Mr. Edwards: May I note with regard to the next patent, the Dunmore and Lowell patent, No. 1,606,212, if your Honor will mark claims 1 to 9, inclusive. And the other patent, the next patent, Dunmore Patent No. 1,635,-117, in that patent will you mark claims 9, 11 and 12; 9 is the one that was before the Circuit Court of Appeals. Here we bring in 9, 11 and 12, the three claims.

Now, I might say at this point briefly, referring back to the Lowell and Dunmore Patent 1,455,141, the patentees employed a type of receiving set which first amplified the receiving signal—the signal comes in very faintly, and it amplifies it. That signal is of a frequency which is too high to be heard; in consequence, in the next portion of the instrument they use a detector, which is one that reduces the frequency down to one which the ear can hear. In the next stage, the audio amplifier stage, the signal, as it comes from the detector is given a much greater volume by a large local power, and comes out in the form of the loud speaker or other equivalent of a telephone receiver.

The Court: Well, we will take a recess here until 2:30.

(Thereupon, at 1:15 p. m., a recess was taken until 2:30 p. m.)

AFTER RECESS.

(Conference in chambers until five o'clock p. m., during which conference counsel for defendants orally presented motion to dismiss bill of complaint as to patents 1455141 and 1635117 because of inadequacy of disclaimers, and at which time the Court adjourned until the next day at twelve o'clock noon.)

Second Day's Proceedings

The Court met, pursuant to adjournment, at 12 o'clock noon.

Present: Counsel for the respective parties.

The Court: Gentlemen, I am prepared to hear from you in line with what was suggested yesterday.

Mr. Edwards: I have two cases in the Supreme Court, your Honor, that it seems to me I should call to the attention of the Court, in line with what was under discussion yesterday. One is the case of Mast, Foos & Company vs. Stover Manufacturing Company, in 177 U. S. page 485. That was a case where the Circuit Court of Appeals of one circuit had upheld the validity of a patent. A motion for preliminary injunction was brought in another district, and the District Court upon that motion held that the patent was invalid in view of the art offered upon that motion. That ruling was affirmed by the Circuit Court of Appeals of the Court which rendered the ruling, and the case went to the Supreme Court. The proposition was advanced that the first ruling practically foreclosed the Court in the second case, and the Supreme Court uphold the ruling, finding that the patent was invalid, saying, "Comity is not a rule of law, but one of practice, convenience and expediency. It is something more than mere courtesy, which implies only deference to the opinion of others, since it has a substantial value in securing uniformity of decision, and discouraging repeated litigation of the same question. But its obligation is not imperative. If it were, the indiscreet action of one court might become a precedent, increasing in

weight with each successive adjudication, until the whole country was tied down to an unsound principle. Comity persuades; but it does not command. It declares not how a case shall be decided, but how it may with propriety be decided. It recognizes the fact that the primary duty of every court is to dispose of cases according to the law and the fact; in a word, to decide them right. In doing so, the judge is bound to determine them according to his own convictions. If he be clear in those convictions, he should follow them. It is only in cases where, in his own mind, there may be a doubt as to the soundness of his views that comity comes in play and suggests a uniformity of ruling to avoid confusion until a higher court has settled the law."

And then there is other language along the same line. That case was decided in 1900, and has been cited, and affirmed and reaffirmed by the Supreme Court in many, many decisions since that time. The latest one, I find, is in 280 U. S., in a case decided in 1929, the case of Sanitary Refrigerator Company vs. Winters, 280 U. S., page 30. In that case a Circuit Court of Appeals had held a patent to be invalid in one circuit, and another suit was brought in the Third Circuit, and a different record made, and the Court of Appeals of the Third Circuit upheld the validity of the patent. The case went to the Supreme Court because of the divergence of opinions. The Supreme Court upheld the Third Circuit.

Now, in that case, as in this case, there was no question of res adjudicata or privity of parties or estoppel involved, but purely a question of comity; and the Supreme Court in the Sanitary Refrigerator Company case said, "Nor have we occasion here to consider at length whether, as urged by Winters and Crampton, the decree of the Circuit Court of Appeals for the Seventh Circuit affirming the interlocutory order of the District Court adjudging the infringement and ordering an accounting, finally and conclusively determined the question of infringement so as to become binding upon the Circuit Court of Appeals for the Third Circuit. The bill in the Dent case was filed before the judgment of the Circuit Court of Appeals for the Seventh Circuit had been rendered."

In this case they were the same parties.

And then the Court said: "This judgment was not set up by Winters and Crampton in the Dent case by any amendment to the pleadings; nor was it even introduced in evidence in that case. In short, there is nothing in the record in that case to raise the defense of res adjudicata or estoppel by judgment; and the only effect of the decree in the Seventh Circuit when called to the attention of the Circuit Court of Appeals for the Third Circuit in argument was, at most, that which it had under the doctrine of comity, constituting a rule, not of law, but of practice, conveniency and expediency; and if we thought the action of the Circuit Court of Appeals for the Third Circuit 'correct upon the merits, we should not reverse its action' so we were of opinion it had not given sufficient weight to that doctrine. See Mast, Foos & Company vs. Stover Mfg. Company, 177 U. S., 485, 488."

Now, as I understand it, we are here this morning for a trial upon the issues raised by the Bill and Answer in this case. We had an intimation yesterday that we would not be permitted to call witnesses to testify with respect to the first and the second patents, the ones that had been involved in the previous litigation. In consequence, we have prepared statements of what those witnesses would testify, if called; and if the Court should hold that we are not permitted to call these witnesses, then I would propose to make the offer in accordance with the Equity Rule 46, in order that if the Court excludes that evidence, we would then have a record, showing that we had proffered the evidence, and that it had been excluded, for whatever reasons the Court advances. I hope your Honor will not think I am too persistent in suggesting that under all the circumstances it seems to me that the short way to get through with this is to make our record. If the defendant is willing to accept these statements as the direct examination of the witnesses the witnesses may be called and cross-examined, and in that way the evidence would be materially shortened, and we would be able to get into the record here our story upon the facts of this particular case.

The Court: Might I see how you have prepared that proffer?

Mr. Edwards: It might be remarked, in a perfectly facetious way, that some one has said that if he had

more time he could write a shorter letter; and that is somewhat our situation here. As you will see, it is somewhat voluminous, but it includes what our witnesses would testify to.

(Paper handed to the Court.)

Mr. Darby: Have you a copy for me?

Mr. Edwards: If, as and when.

The Court: Have you had a copy of this, Mr. Darby?

Mr. Darby: I just asked for one, and Mr. Edwards seemed rather reluctant to let me see it.

Mr. Edwards: It does not seem to me unless and until we are in the trial of the case and make this offer in a formal way that we should submit a copy of this to counsel for the other side, and thereby apprize them of our entire case, in which case, if there is some subsequent adjournment and the trial does not proceed, they have our case in detail, and we do not have theirs. Before we submit this, it seems to me we should know whether we are in the midst of the trial and we are making formal offer of this evidence.

The Court: Are some of these witnesses, but not all of them, the same ones that testified in the other case?

Mr. Edwards: Yes, sir, I believe all of them except Vandeventer; all except Vandeventer testified in the other case on various matters—not to the same matters that are included in these statements.

The Court: Well, they were available for the same testimony, weren't they?

Mr. Edwards: I do not think so, because many of the statements contained in there were either not known or not appreciated by our witnesses at the time of the other trial.

I might have mentioned in connection with that Mast-Foos case that the court there referred to the fact that the second case might bring in additional testimony of other facts which would lead to a different conclusion than was reached in the first case.

The Court: There is one other question that I want a little more light on. In reading the opinion again in the Court of Appeals for the Third Circuit and some other cases, the question struck me whether, as a matter of fact, in view of the state of the disclaimers in this case whether the construction of those disclaimers or the claims as modified by them is not a matter that ought to be determined by the Delaware court anyway and not by this Court, or whether it is not a question of a reissuance. Now, what have you got to say on that.

Mr. Edwards: I think, sir, that that is a matter that can be determined only in this court and by your Honor in view of all the facts and circumstances and after an examination of the patents and the prior art, to determine whether the disclaimers were necessary, and the effect thereof. There was no way that I know of of bringing the matter to the attention of the Delaware Court.

The Court: Well, now, is that true? As I read the opinions—of course, I have not seen the decree—but the opinion declared invalid the various claims. Now, ordinarily, were these simple claims, not involved in a lot of technical elements, like you have here, that would end the matter. Those claims would be out of the picture. Isn't that true?

Mr. Edwards: They might or might not be, sir, under the circumstances.

The Court: Take a very simple case——

Mr. Edwards: I go with you to this extent, that a man with a very simple patent should be required to act with much greater promptness than one where the situation is difficult and the invention complex.

The Court: But I am asking, if a higher court in a given jurisdiction declares a simple claim, a claim which we will assume now could not be revamped, declares it invalid, then that is out of the situation.

Mr. Edwards: No, sir, I do not agree with that, because I insist that under the Mast, Foos & Company case and the numerous other cases cited, that that patentee is not obliged to accept that opinion, no matter what it says.

The Court: I mean out of the situation, in so far as that court is concerned.

Mr. Edwards: Yes, sir.

The Court: I meant to add that.

Mr. Edwards: Yes, sir, in that circuit.

The Court: If, however, the claim is of such a character that the plaintiff feels that it can be reconstructed, so to speak, so as to meet the requirements, or rather to void the charge of invalidity, isn't that, then, a question to be determined by the Court that passed upon it, or by the Patent Office?

Mr. Edwards: I do not think so, sir. And I do not know how it would be brought up, unless possibly by some bill on review. But if you attempted to proceed in the same Circuit, you would probably be met by the situation like in the Hoe case, where the Court said, If you want to go any further in this case, you will have to file a disclaimer, because, so far as this Circuit is concerned, we are through.

The Court: What I am getting at as a practical matter is this, wouldn't it certainly be most helpful to a court of another jurisdiction, including this one, if the plaintiff believes that he can so amend these invalid claims as to make part of them still valid, wouldn't it be most desirable for the Court that had the most to do with those claims to do that?

Mr. Edwards: I do not think so, sir, because, even if you did do that, you would be right back where we are now. Suppose these disclaimers had gone to the Court and the Court said either that they are no good or that they are good, or any other ruling, that would not prevent further litigation; and the next court would have to meet a situation on the record as presented to that Court. Now, here, in this situation I would like your Honor always to keep in mind that on the decision of the Circuit Court of Appeals, these men did something of great value.

I neglected to read from Judge Wooley's opinion regarding this receiver patent.

"This is a highly scientific organization"—referring to this patent—"and this is what Lowell and Dunmore say they invented. Looking at it as they disclose it, that is, looking at it close up, without looking at its background, it would appeal to any one that is invention.

"If they had invented this apparatus and all its elements, their invention unquestionably would have been basic; it would have been more than that; it would have been stupendous, for it would have covered the major portion of the practical radio art as it stands today."

Now, that *it* what Judge Woolley said would have been the case if the facts were as we said they were, namely, if this apparatus operated the way we said it operated.

The Court: Well, now, that is just my point. You are asking me to listen to the same story, but you are going to put it on a little better, like the second performance is always expected to be a little better than the first. It is always better than the rehearsal.

Mr. Edwards: We hope so, and we expect to add a few extra features.

The Court: Now, then, you are asking me after the judges of that Circuit gave all the time and thought to these questions—and you have gone to the Supreme Court and have been turned down—you are asking me to go all over that as a whole, thinking that I may take a different view after hearing your arguments and the arguments on the other side, and being told what you propose to offer, and having read and reread, as I have again this morning, both opinions in the Court of Appeals, you nevertheless are asking me, merely on an expectation that I will reach a different conclusion—all I say now is that on such knowledge as I am able to muster on a matter of this kind, considering the main questions that are brought out, I find nothing wrong in what they said. And, therefore, I do not see why comity or any other rule requires me to make up another record, in the bare possibility that I may detect some erroneous finding of an appellate court, and, in effect, of the Supreme Court. Now, that is what I would do in a contract case, if I were prima facie satisfied, and I would say that I would abide by the ruling here. I think the matter is further complicated

by these other questions rather than the disclaimer, and I would like some further light on this point, because I confess it is entirely novel to me. If claims have been declared invalid by a court of another jurisdiction, is it quite the proper practice to come into the second jurisdiction and ask the Court sitting for the first time in the matter to reconstruct those claims which that other Court has thrown out? I do not like it; it does not appeal to me as being sound practice, because, assuming that they are capable of reconstruction, it seems to me the appeal ought to be made to the Court that lived with those claims and studied them and determined they were invalid, and why they were invalid. Now, I am not saying that there is prohibition against my doing it, but it seems to me that simply adds weight to the first argument which I heard, that this Court is being asked to do something which is not only unnecessarily burdensome, but which will destroy finality of decision, and encourage litigation in patent matters, which I am opposed to doing.

Now, I did not want to interrupt you. Have you anything on that point?

Mr. Darby: Yes, sir, I have this: Yesterday I was rather of the impression that it would require testimony to support the proposition which, I think, has been more or less freely admitted by Mr. Edwards, that even as disclaimed in language the disclaimer is not in effect a disclaimer. Therefore, in view of the argument and the enlightenment as to the subject matter that the Court has received, I would like to add to my motion to dismiss the ground that no disclaimer has been filed, which relegates the patent—that is, no adequate disclaimer has been filed, no disclaimer which even purports to meet the invalidation, or is directed towards meeting the invalidation, has been filed, which thereby places the patent squarely under the Statute, which says that the patent can not be proceeded under in a patent infringement suit anywhere in the judicial system.

The Court: I would like to hear Mr. Edwards first on that. But I must say, after reading the claims again, the ones that were declared invalid, and reading the disclaimers, that it is impossible for me to say whether you have not just attempted to set up in other language, by reservations, what the Court has knocked out.

Mr. Edwards: I do not see how your Honor can pass upon that question without having before you an understanding of what the patent is, the devices themselves, the prior art, and all that sort of thing.

The Court: Aren't you asking me then to do the job of the Patent Office?

Mr. Edwards: Not at all, sir. I think I am only asking the Court to do that which, under these decisions to which I have referred, and what has been done over and over again in the last thirty-six years, and that is to allow us to make our record on the issues raised in this particular case. I submit that, stripped of all else, we have here a bill and an answer. Now, there are two courses, you might say, that are open. One is the suggestion that notwithstanding everything else, and as a pure technical defense on the bare subject of delay, that the whole case should be dismissed. I was not going into that, because I think that has been disposed of. And obviously, if these men invented something, it would be a terrible thing to throw them out of court because of the fact that their delay is considered unreasonable.

The Court: I want to say that I am not prepared to rest judgment entirely on that ground.

Mr. Edwards: Your Honor brought up what I must admit is a much more practical proposition. I realize all that your Honor has said about the desirability, perhaps, of having only one court pass upon these questions, about the objections, such as they may be, in going into other jurisdictions; but, after all, your Honor, isn't that a question of expediency rather than a question of right? As a matter of strict law, we come here with a Bill and Answer, and are we not entitled to make a record? If your Honor sees fit to exclude and make a ruling that we are not allowed to take any evidence under our Bill, of course, that is within your province, and all we could do would be to except. Your Honor could, of course, either allow the witnesses to go on the stand, and then adhere to the intimation given by you that in spite of that testimony it would not change your outlook on the case, or if we are to take a short cut and the evidence is excluded, I submit we are at least entitled to have on the record that which we offer to prove, and then we have made a record in which we have offered to prove certain things,

and from that time on, of course, it is the province of the Court to decide whether or not that evidence would or would not change the Court. But, as I say, stripped of all else, are we not vacillating between two questions, sir, one the question of our right to maintain the action and to put in our story, and the other the question of all of the disadvantages, the interruption of the work of the Court, and the time and complexity and difficulty of all those questions, which, after all, I submit to your Honor, are questions of expediency and not questions of right.

The Court: Mr. Darby, do you want to say anything further?

Mr. Darby: Not unless your Honor has something in particular.

The Court: Have you any cases on that last point I referred to, about the matter of disclaimer?

Mr. Darby: On the matter of the disclaimer being adequate?

The Court: On the question that I raised about the character of the disclaimer and the necessity or desirability of the matter not being placed upon another judge ab initio.

Mr. Darby: I have no authorities on the latter phase that comes to my mind, your Honor. On the first phase of it there are plenty of authorities, that a disclaimer must be as extensive as to the grounds of invalidation. There are plenty of authorities on that. The authorities are entirely uniform on that. But on the question of it being heard by the Court that originally invalidated the patents, I do not think offhand of any authorities.

The Court: Well, is it your contention that you could show me now that it is as extensive as the invalidation?

Mr. Darby: Oh, absolutely.

The Court: Have you a copy of the decree? Were there any qualifications in the decree that followed these decisions?

Mr. Darby: The decree is merely to the effect that claims 3 and 14 are invalid, and the Bill is dismissed for want of equity. That is the standard form of decree in

the Delaware Court. The interlocutory decree which was appealed from, of course, held the patent to be valid anyhow, after the mandate of the Court of Appeals went down. It is the standard form of decree that the claims were invalid, and the claims were dismissed for want of equity.

The Court: It seems to me that the plaintiff puts back all its aggregations again in another form.

Mr. Darby: That is exactly what happened. As I say, that appears from the face of the patent which is before the Court upon my motion, and forms an absolutely sufficient ground in itself, and certainly forms an additional ground, taken together with the disclaimer, for the granting of the motion. It forms such a sufficient and such a solid ground that I certainly have no desire of inducing this court to render a decision which could not stand before an appellate court. I would not do so. I would be the loser in the end. And I am thoroughly satisfied and contented with those grounds.

The Court: Now, turn for a moment to the Patent No. 1,455,141, and to the disclaimer, and turn to 3. 3 and 14 are the ones that were thrown out, are they not?

Mr. Darby: Yes, sir.

The Court: Well, now, if you read 3 as declared invalid——

Mr. Darby: Claim 3.

The Court: ——wherein is there any difference between that and the disclaimer or reservation?

Mr. Darby: There is no difference whatever. The Court held the patent to be invalid because——

The Court: The claim——

Mr. Darby: The Court held the claim to be invalid because of aggregation of those three elements, those three different means in the radio frequency section, in the detector section and in the audio frequency section. All three of those or any one of those three would operate to eliminate hum in their particular section, wholly irrespective of whether or not there was hum in either of the other two sections. That was the effect of holding

an aggregation by the Court of Appeals. Now, they disclaim as to claim 3 all separate means connected with said amplifier and rectifier——

The Court: Where are you reading from?

Mr. Darby: I am reading from the disclaimer.

The Court: On the bottom of page 6?

Mr. Darby: On the bottom of page 6, paragraph No. 3. They disclaim any source of alternating current for supplying power to said amplifying means as set forth in claim 3, except such as supplies raw alternating current to the cathode heating circuit or circuits and rectified current to the plate circuits of such amplifying means. Well, now, that is all that they showed in their patent originally, so they are disclaiming everything that they did not show. That is what that amounts to. Now, the other part, which is the more important part, they disclaim any means, any separate means connected to each of said amplifying and rectifying means for eliminating the hum of said alternating current, except as stated, and there they have enumerated under A and B the separate means that they disclose in their patent. In other words, there can be no question whatever that if claim 3 as originally filed is invalid because of aggregation, it is just as invalid because of aggregation in its disclaimed form, because instead of disclaiming the utilization of separate means they disclaim all separate means except the enumerated separate means, which is not a disclaimer at all. And your Honor will recall—that I think was more or less admitted by Mr. Edwards yesterday. He first took the position that no disclaimer was necessary at all.

The Court: Well, that seems to be a fair argument, and if it is sound as to that claim, it is equally sound as to 14, as I view it.

Mr. Darby: Yes, sir.

The Court: And it is equally sound as to claim 9 in the other patent.

Mr. Darby: Absolutely.

The Court: Now, Mr. Edwards, how do you answer that?

Mr. Edwards: I say, if that argument is sound, sir, and the claims put back this so-called aggregation, then there never was any necessity for a disclaimer, and Mr. Darby's whole motion falls. Because, then he would have the patents back the way they were, and the disclaimers would be out of it.

The Court: As I read it with the reservation, leaving out any knowledge of what the words mean, the disclaimer does seem to disclaim what the Court has said was invalid, and then by reservation they put back at least the major material elements. I do not have to have any knowledge of what they mean, but just put back the terms.

Mr. Edwards: I think, sir, in simple——

The Court: That, it seems to me is flying in the face of what the Appellate Court of the Circuit said was invalid, and you are asking me to still reopen that, and after hearing all the case, to see whether I do not think you are justified in that, or if not in that, then to differ with the Court on some of these other claims which were not knocked out, but which are admittedly very much broader than the ones here.

Mr. Edwards: I do not construe those disclaimers in that way. I say if they are so construed——

The Court: Well, I may have a poor ability to interpret language, but that is the way they strike me, as I read them.

Mr. Edwards: My position is simply this, that I do not see how you can construe those disclaimers without having before you a clear explanation of how the patent operates and what the prior art is. I do not see how you can do it. That is my first position. May I add another thought?

The Court: Yes.

Mr. Edwards: My interpretation of those disclaimers goes simply to this, as simply as I can state it: These claims all show means for eliminating hum. Now, whatever language they use, those means would mean nothing more than the substantial equivalent of what this patentee showed and described, and those disclaimers

mean nothing more than saying the means which were described are the specific means shown in this patent, or their equivalents. Now, I do not myself see where that introduces any great difficulty. It may raise a question whether that was merely a matter of precaution or of necessity, but as I said before, I do not see how the Court can pass upon that without knowing all of the circumstances; and I look upon that as a branch of the other proposition, namely, we are here on bill and answer, and are we to be allowed to make a record or not?

The Court: Have you the disclaimer on 9 before you, the claim 9 in that patent?

Mr. Darby: Yes, your Honor, claim 9.

The Court: Now, let me see, that is in 1,455,141?

Mr. Darby: 1,635,117.

The Court: Yes. I do not think I have the disclaimer before me. Yes, I have.

Mr. Darby: That is in Paragraph 2. He disclaims any filament electrodes specified in claim 9, except such as are energized by raw alternating current, and any means for supplying a negative potential to the grid electrode of said electron tube, from said source of alternating current, as specified in the claim, except such means as comprise a bias determining resistance connected in a series path between the grid and filament electrodes and shunted by a condenser of low impedence to power supply frequencies.

Now, if you refer to claim 9, they have done virtually the identical thing in this patent that they did with the other patent. They have disclaimed what the Court of Appeals held to be invalid, and then reserved by anticipation the thing that they disclaimed by the specific instrumentality shown in the patent. It is not a disclaimer at all. And, of course, I submit to your Honor, in view of the explanation that has been had, you do not have to have evidence to determine the sufficiency of the disclaimer; you do not have to consider the prior art. You have to consider nothing more nor less than the claim of the patent as it appears on its face, and the opinion of the Court that invalidated the claim, and then the disclaimer itself, and ask yourself the simple ques-

tion, has that disclaimer by the patentee disclaimed that which the Court has held to be invalid? And the necessity of doing that is the statutory requirement before a suit can proceed on the patent in any jurisdiction. That is the expressed provision of the statute.

Mr. Edwards: I do not understand that there is any such statutory provision. The statute is that after a patentee becomes aware of the invalidity of his claim he must disclaim within a reasonable time.

The Court: Well, it provides, of course, in cases where the court has invalidated them that——

Mr. Edwards: Where it has gone to the last jurisdiction, or the circumstances are such that the patentee should be aware that that is the last decision.

Now, let me take that claim. It is a fair sample of the other disclaimers, and I think I can illustrate what they meant by reason of that. Claim 9, you will note, calls for filament electrodes. The filament electrodes are the filaments which are heated by the current. In the old art they were heated by batteries. So this patentee disclaims any filament electrodes except such as are energized by raw alternating current. His patent shows no other kind of filament electrodes except such as are energized by raw alternating current. He was, therefore, doing nothing more than to say that the claim means that which I have shown with respect to that element. Then the claim further says—it disclaims any means for supplying negative potential to the grid electrode of the said electron tube from said source of alternating current, as specified in claim 9, except such means as comprise a bias determining resistance connected in a series path between the grid and filament electrodes and shunted by a condenser of low impedence to power supply frequencies.

Now, in his patent he had shown and described nothing else than a resistance 18, shunted by a condenser 19, in series in the grid circuit, the condenser being of a low impedence to power supply circuit. He had shown no other way of doing it; so with that disclaimer analyzed, it is not anything more than saying, I do not want my claim to be understood as claiming anything but what I have shown.

Now, as to whether or not that is a proper disclaimer to do that, whether or not it was necessitated, there being no prior art that necessitated any such thing, are purely matters to be determined by the Court after consideration of all the facts.

Likewise, suppose it does leave the claim open to the objection that it does not avoid what the Court of Appeals for the Third Circuit said. I say to your Honor that is a matter of comity, not adjudicata.

The Court: Well, the ultimate proper decision, if the disclaimer is not a proper disclaimer, is that the Bill should be dismissed, because you should not proceed until the invalid matter is gotten out of the way.

Mr. Edwards: Not at all. I submit to your Honor you would then be met with this question: Suppose you should hold that those disclaimers do not change the situation over what happened in the Circuit Court of Appeals in the Third Circuit. You would then hold that the disclaimers are invalid. We would then meet the question, was it necessary for us to file a disclaimer at all in order to maintain a suit? Now, that is the question under all the circumstances. In the first place, there is no reason why a patentee should be obliged to accept that decision. He should certainly be allowed to wait until he has every opportunity of testing the case. And if the Court should hold later, as I think it would, that the decision of the Circuit Court of Appeals was wrong, then no disclaimer ever was necessary.

The Court: Well, now, right there, Mr. Edwards, I do not think I can follow you, because yesterday we had extensive argument on the cases, the soundness of which I understood you to accept to the effect that disclaimers must be made effective within a reasonable time, whatever the patentee may consider to be a reasonable time, after a final decision of the Court with proper jurisdiction.

Mr. Edwards: Not quite that, sir. Within a reasonable time after the patentee becomes aware that the patent is invalid, and always subject to the fact that the claim is invalidated. Now, the decision of the Circuit Court of Appeals does not make that claim invalid, except in the Third Circuit. It is not invalid elsewhere.

In this Court, if we prevail upon the facts and show that the claim is valid, that it is not an aggregation, that it is not a mere matter of supplying direct current to the tube, then no disclaimer ever was necessary. That brings me right back to the fact that this Court would have to hold or insist that the claim is invalid. It does seem to me that in every turn of this argument we come back to that one simple question, and that is whether these matters are to be treated as matters of comity, or whether they are to be treated as absolutely foreclosing us from making a record in the case.

MEMO.

At this point the Court ruled orally that the defendants' motion to dismiss as to the two patents, Nos. 1,455,141 and 1,635,117, on the ground of inadequacy of the disclaimers should be granted. The views expressed by a court in so ruling are embodied in the final opinion of the Court on file in this case.

Mr. Edwards: Your Honor, may we have it on record that we offer to produce witnesses and offer to give testimony, as in the memorandum handed up this morning; and may we have an exception to the ruling excluding that?

The Court: Yes, you are entitled to all of that.

Mr. Darby: May I explain to the Court that Mr. Edwards and I have stipulated that the testimony given about this third patent in the previous case may be received here as our testimony. Therefore, all that I need to add to that is brief testimony by an expert, to point out the identity between our receiver, our loud speaker, rather, which is now charged as infringement, with the loud speaker which Judge Morris held did not infringe. Very specifically, I do not think they do. There are differences that exist between our speaker and theirs. So that is all my case will be limited to.

The Court: Very well, gentlemen, we will go on at half-past two.

(Thereupon, at 1:30 o'clock p. m., a recess was taken until 2:30 o'clock p. m.)

After recess (2:45 p. m.)

Mr. Edwards: If your Honor pleases, before I start patent No. 1606212, may I be clear about the record on

the other patents. As I understand it, the proffer of depositions and exhibits was excluded and an exception granted and they are to be marked under the provisions of Equity Rule 46 as a part of the record: Am I correct in that understanding?

The Court: I think so. I think that is correct.

Mr. Edwards: That is the rule, you will remember, that provides that where evidence is offered and excluded it may be marked and made a part of the record in order to show what was offered.

The Court: Have you anything to say about that, Mr. Darby?

Mr. Darby: My understanding is, if the Court pleases —I have not any objection to the record showing that a proffer was made—but my understanding is that the motion to dismiss was granted in advance of trial, and as long as the record shows that, then what in addition it shows, I care not.

The Court: I did not understand your last statement.

Mr. Darby: As long as the record clearly shows that the motion to dismiss was granted in advance of trial, I do not care what else is shows.

Mr. Edwards: I have been under some uncertainty from the beginning as to just what period we entered on the trial of the action, assuming as I did that we were in the trial of the general case, and we offered these documents, then we were to have the right under Equity Rule 46 to have them marked.

The Court: I do not think we have ever gotten to the trial, have we?

Mr. Edwards: If this was before the trial, then, I take it, that the record as it stands showing that they were offered before your Honor made the decision would cover the situation. I am merely, out of precaution, endeavoring to be clear that the record shows just what was offered prior to the decision, whether that decision is supposed to be prior to or during a trial.

The Court: Now, a lot of that does not relate to the point on which I decided the matter, does it?

Mr. Edwards: I think it does, sir. As I understand the point of your Honor's decision, it is to the effect that notwithstanding our offer to prove these matters, that under all the circumstances you think we should not be permitted to come in and make a record, and whether it be used from that standpoint or from the more technical standpoint, but, after all, this is a trial under Bill and Answer, in the course of which we offered this as evidence, as we do, it may be immaterial. As I understand the situation, we are here on what amounts to a trial of the action under the issues raised by the Bill and Answer and we offered this statement of what we proposed to prove and the Court has refused to receive evidence to that effect, in which case the procedure would be to mark the proposed testimony and exhibits under Rule 46, and it would go along merely to show what occurred at the trial.

The Court: I have not any objection to it, but it does occur to me that this might be treated like the ordinary case in which there is a motion to dismiss the Bill. It either stands or falls, and if your Bill is dismissed, you appeal from the final order and if that appeal reverses the situation, then you come back. I do not see quite how the testimony enters into it now. However, I am not precluding you ultimately from submitting the testimony if the Court of Appeals says I have to.

Mr. Edwards: Well, precisely, sir, but in order that the Court of Appeals may know whether or not that testimony should have been received, it will need to know what was offered, and the purpose of Rule 46 is precisely that, that this offered testimony should be marked under the provisions of Rule 46.

The Court: Aren't you getting in, under that, all your side of the case, in effect, and we have not come to that?

Mr. Edwards: Well, in a way that is what Equity Rule 46 provides, that where the Court refuses to receive evidence——

The Court: Yes, but that is in the trial of the case.

Mr. Edwards: Well, but would it not be even more unfair to dismiss our Bill out of hand without even hearing what the plaintiff proposed to do? That is, your

Honor has suggested from time to time that these issues are more or less concluded and that this and that is similar to some other situation and I think we are entitled to have the record here show precisely what happened—at least after the discussion started and before the decision we filed a definite offer to prove certain things, that, therefore, it should be a part of the record, not as evidence, but merely to show what happened.

The Court: Well, I will allow it in now subject to further consideration. I am not disposed to encumber the record on appeal with a lot of stuff that should not be contained in it. What I want the Court of Appeals to decide is whether I am right or wrong on the question of disclaimer. If I am right, the Bill was properly dismissed, and if I am wrong, it was not, and will be sent back for further testimony. However, I understand you do not object to it?

Mr. Darby: I do not object to it appearing on the record that that offer was made, but I agree with your Honor that Equity Rule 46 comes into play only after the commencement of the trial, which is not so in this case.

Mr. Elwards: I submit we have had a trial on that, Your Honor has taken up this matter of Bill and Answer and you have dismissed our Bill. Now, surely we are entitled to have the record show, therefore, that your Honor did it without anything, and, particularly, are entitled to show that we offered and definitely filed a written offer to prove certain things and that in spite of our offer to prove those things, our Bill was dismissed.

The Court: Well, I will allow it in subject to further consideration. I want to give that some further thought.

Mr. Edwards: In connection with the Patent 1,606,212—I shall not stop now to make any opening explanation of the patent because it is so simple—we will put Dr. Lee on the stand and ask him to point out the relevant features and then compare those features with the defendants' speaker. I offer in evidence U. S. Letter Patent No. 1606212 granted November 9, 1926, to Francis W. Dunmore and to Percival D. Lowell, as Plaintiff's Exhibit 90.

Mr. Darby: No objection.

Mr. Edwards: It is admitted, is it, Mr. Darby, that the title to this patent is in the plaintiffs as alleged in the Bill of Complaint?

Mr. Darby: For the purpose of this case, it is.

The Court: Now, what claims are you considering now?

Mr. Edwards: Nos. 1 to 9.

Thereupon DR. FREDERICK W. LEE, a witness of lawful age, produced on behalf of the plaintiffs, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION.

By Mr. Edwards:

The Witness: I graduated from Cornell University in the Electrical Engineering Department in 1911. I was assistant at Harvard University from 1911 to 1913, working under Dr. Kennelly at that time. In 1914 to 1915, I was at Johns Hopkins University, working on the application of radio to geo-physical prospecting. From 1916 to 1928, I was on the faculty of the Electrical Engineering Department of Johns Hopkins University, and the last years of which I was Associate Professor of that institution, teaching radio to the students of the University. Since that time I have been engaged in consulting and private practice on radio questions.

Referring to Patent 1,606,212, I will explain briefly how the apparatus shown and described in that patent eliminates hum in the loud speaker portion of the apparatus. The diagram of patent No. 1606212, shown in Figure 1, consists essentially of an audio frequency amplifier operated upon by the input circuit 1-2, receiving its power supply from an alternating current source in transformer primary terminals No. 27 and 28. To this transformer are connected various secondary circuits, Circuit No. 22——

The Court: Well, now, couldn't you take it—haven't you got one here—and as you explain that, couldn't you put your finger on each of the elements?

Mr. Darby: You see, the difficulty is, your Honor, they have not got anything here that was constructed under the patent. They have got defendants' apparatus.

Mr. Edwards: We have defendants' apparatus, and it has gone into very wide use.

The Court: Well, haven't you got a model of plaintiff's instrument?

Mr. Edwards: We have the model of the other patent here, and I think we have portions that will be relevant.

Q. (By Mr. Edwards) Dr. Lee, in explaining this patent, can you make reference to the apparatus here on the table, and, as you go along, point out in that apparatus the physical parts that correspond to parts in this patent to which you refer. For example, you have referred to audio frequency amplifiers, meaning tubes 5 and 7. Could you point out such amplifiers in any of this apparatus on the table before you? A. I will refer to this bread board model and show where the audio frequency amplifier is, what it looks like, how it looks in the bread board model in this exhibit is marked by the letter C. The audio input circuit is at the yellow terminals, which I will call A and B. These correspond to the terminal of 1 and 2 in the diagram of the Figure 1 of the Dunmore patent. The audio frequency transformer, 11, would correspond to transformer No. 4 in the patent diagram. This circuit does not have two stages of audio frequency amplification, but only has one, so we can consider that transformer No. 4 functions essentially as transformer No. 6 in the patent diagram. The tube, the vacuum tube under question, would therefore resemble vacuum tube No. 7 on the patent diagram. No. 7 is labeled No. 13 on the bread board model. This vacuum tube No. 13 receives its energy or excitation from a transformer through the circuit, which I will mark C. That circuit corresponds to the transformer secondary No. 20, in the patent. And circuit No. 20 in the patent also supplies the filament current for vacuum tube No. 5 as well as No. 7.

Circuit No. 20 is from transformer No. 24, on which secondary 25 corresponds to secondary 20 in the patent drawing. The primary winding of this transformer connects primarily to the alternating current service in

Circuit No. 28. Across this secondary circuit C, which feeds the amplifier, 13, there is a midtap connection, consisting of a resistance, 18, on the bread board model and 11 in the diagram. The plate circuit of transformer vacuum tube No. 13 passes into the primary of transformer No. 33. This corresponds to transformer No. 8 in the diagram.

The Court: That, Doctor, is not helping me any. You are just taking the drawing, and you are telling me how the drawing matches. Can't you, in simple layman's words, tell what the invention is?

The Witness: Yes.

The Court: You have not used a single word that would be clear to a layman; and you assume that I know these technical phrases. Can't you describe what this thing is in ordinary language? Can't you tell me what its object is? That is what I want to know. If you can do that, then I can understand it.

The Witness: Surely.

The Court: If you simply say that those things represent these drawings, that does not help me a bit.

The Witness: Well, I wanted to come to that later, your Honor, if you will permit.

The Court: Well, if you want to start that way, all right, but this does not help me to understand it.

Suppose somebody came in—suppose you were instructing a class in this and wanted to tell them what the idea was, could you put it in clearer language than that?

The Witness: Surely. But I was identifying the circuit with the diagram in the patent, in order to show the parallelism. Now, I will state it very briefly: In the ordinary radio audio frequency amplifier set the signal or radio or audible speech——

The Court: By signal you mean that noise that comes out, the sound?

The Witness: By the signal in that case I mean the speech which is transmitted to the instrument is amplified by the ordinary vacuum tube. In such amplifica-

tions, if the tubes be operated purely on direct current, under the ideal system, eventually, after passing through those tubes, you would get the same signal amplified to a higher degree. Now, if the tubes have in them elements of disturbance, of annoyance, of hum, which superimposes itself upon the signal, then the objectionable hum also comes out of the output circuit of that system. This patent describes a method of eliminating a portion of this hum which comes from the secondary or the output circuit of the last transformer, and shows how this hum may be eliminated in the speaker itself. The speaker itself consists of two circuits, one circuit which you may call the energizing circuit of the speaker, and the other circuit you may call the armature, or moving element of the circuit. This moving element of the circuit is connected directly to a cone, and the movement of the circuit causes the cone to move in exact ratio to the energy in this armature circuit which converts electrical energy into sound energy. This patent states that if you have in this armature circuit a hum, you can have another hum in the energizing circuit, but select your connections in such a way that the two hum impulses neutralize each other and thereby eliminate the hum which would arise through the circuit. That, in sum and substance, tells the story.

In the patent the coil which is the moving coil connected to the tube of the receiver circuit is coil No. 9 and coil No. 10 is the energizing coil.

As to whether the pulsating current from the rectifier, 4, in passing through the coil, figure 10, has anything done to it in the way of smoothing out fluctuations, I will say that the only smoothing-out effect is through the inductance in the coil No. 10, which would tend to keep the current flowing in coil No. 10 once it had started therein.

Mr. Edwards: Mr. Darby, will you admit that this apparatus before us, that is to say, the portion showing the tubes, condensers and the loud speaker but not containing these switches, was manufactured and sold by the defendants in this case, within six years of the filing of the bill of complaint and subsequent to August 5, 1933.

Mr. Darby: On your statement made to me this morning or yesterday that that receiver was purchased from

a distributor or retail dealer of Stewart & Warner receivers I am perfectly willing to accept your statement.

Mr. Edwards: I do make that statement. I have here the bill of sale for the instrument, dated August 17, 1933.

Mr. Darby: I won't put you to the proof.

Mr. Edwards: I will offer in evidence the Stewart-Warner set, set up on the model, just referred to by counsel, and ask that it be marked Plaintiffs' Exhibit No. 91.

(The set referred to was marked "Plaintiff's Exhibit No. 91.")

Q. (By Mr. Edwards) Before you get to that model, Dr. Lee, let me ask you one or two other questions. As I understand you, the signal coming out of these amplifier tubes 6 and 7 is a frequency carrying the voice signal. A. The audio frequency is always considered to be a voice frequency so it would be a voice signal.

The Witness: As to the question asked me as to what form this voice signal is in when coming out that is, whether there is a carrier wave, I will say that along the circuit it has not any carrier wave connected with it at all. It is just purely the ordinary telephone or voice circuit. That is a frequency within the audible range, which generally runs from 60-cycles per second to maybe 10,000 cycles per second but is usually about three or four thousand cycles per second. 8,000 cycles per second is considered the ordinary telephone frequency. The frequency in the rectifier tubes of the patent is of the order of 60 cycles a second. That of the model is of the order of 120 cycles per second. The ordinary house lighting circuit is usually 60 cycles a second and 120 cycles is just twice that. That is well within the audible range. This audible range is of the order of about 60 cycles per second.

In this patent the signal frequencies are coming from the receiver elements 5 and 7 through the transformer 8, and the power frequencies are coming from the rectifier elements connected to the transformer. That is, through the rectifier tube, 18, of the patent. One frequency is connected to coil 9 and the other to coil 10 as to whether these frequencies are in phase opposition, I will say that

you can not tell whether they are in phase opposition by looking at the diagram. The only way you can tell they are in phase opposition is by first connecting them in one direction to your system and then reversing either on 10 or 9, in which case you will have an added hum, if there is such a phenomena present, or there will be no hum at all if the phenomena does not exist. The specification specifies that the coils should be connected in such a manner that there is no hum from the system. The patent means that the current supplied to 9 and the current supplied to 10 should be flowing so as to neutralize each other pursuant to the force upon the armature connected with it. They are what we call in phase opposition.

I will refer to plaintiffs' Exhibit 91 and state if I find in that exhibit the elements corresponding to the audio amplifier, the rectifier for furnishing current to the tubes and also the loud speaker element to which I have referred.

The loud speaker elements are the armature and the field circuit, which I will call the reversing element circuit No. 1 and the double system of circuits containing both an armature and a field by the combination of wires composed of white, green, yellow and red circuits.

In other words, there are two pairs of circuits there which make up this combination; one pair is for the field excitation and the other pair is for the armature.

I will demonstrate on that model how the loud speaker operates when these two coils in this circuit are connected in phase opposition and how it operates when they are not so operated.

(Demonstrating) There is just a little element of time required to heat the tubes. Now, under this condition you have also the incoming signal. In order to demonstrate the effect of the phenomena alone, it is more convenient to eliminate the signal entirely and just hear the phenomena of hum. I have, therefore, detuned it slightly. Now, that is a normal connection and there is some hum, very slight. This (indicating) is the reverse connection.

When I say this is the reverse connection I mean I have reversed the armature circuit of the speaker.

When I say I have reversed it, the condition the coils are left in is as follows:

That condition requires that the coils should be not working in phase opposition but the effect should be such as to amplify the hum rather than to compensate or balance the hum out. At the present time in this condition the speaker is operating not in phase opposition, and in this condition there is a very distinct hum being delivered from the speaker.

Mr. Edwards: If your Honor will listen to that for a minute I think, perhaps, you can hear it from here. I do not know whether your Honor can hear it?

The Court: Yes.

The Witness: I will reverse it now. When I reversed these coils I placed the hum currents in phase opposition so that they neutralize each other in the armature of the speaker. The hum in this case is greatly reduced.

I am shown a sketch marked, Stewart-Warner No. 109, and asked if that represents the connections employed in this model during test to which I have just referred. I will say that this circuit substantially represents the circuits in the model described.

I will state what there is to show how the circuits are connected and what that represents. In this circuit there is represented the last stage of the audio stage which amplifies the signal before the energy is supplied to the armature of the loud speaker. From the secondary of this transformer a connection is made to the armature of the loud speaker shown by the yellow circuit. In this circuit is interposed a reversing switch, usually called the 2 pole double throw switch. After the circuit passes through this reversing switch it enters directly into the armature circuit. The field circuit of this loud speaker is also indicated in the form of a black circuit which receives its energy from the propor portions of the set.

Mr. Edwards: I will offer in evidence the diagram referred to by the witness and ask that it be marked "Plaintiffs' Exhibit 92".

I also offer in evidence the stipulation entered into by counsel for the respective parties and dated June 5, 1934,

regarding the sale of certain apparatus by the defendants, as "Plaintiffs' Exhibit 93."

The Witness: Referring to the diagram marked, "Chassis Model 109", forming part of this Plaintiffs' Exhibit 93, I have colored a photostat copy of that diagram to indicate the rectifier and loud speaker circuits as shown in the diagram attached to the exhibit. The rectifier circuit of this exhibit is indicated by a purple line. The loud speaker portion of this circuit is indicated by a brown line and the circuits can be followed through the using of the colored circuits.

Mr. Edwards: I will offer in evidence the colored copy of photostat shown the witness and ask that it be marked, "Plaintiffs' Exhibit 94".

The Witness: I have prepared a simplified diagram showing the circuits in the photostat which have been colored. The simplified diagram is represented by Exhibit 95 in which also the loud speaker circuit is colored brown and the rectifier portion of the alternating circuit is colored purple. The circuits shown in this Exhibit 95 are substantially the same circuits as in the photostat marked No. 109, forming part of the exhibit.

Mr. Edwards: I offer in evidence the colored diagram referred to by the witness as "Plaintiffs' Exhibit 95".

The Witness: Referring to this colored diagram, I can identify briefly the loud speaker circuit to which reference has been made by me. The armature of the loud speaker circuit receives its energy from audio frequency transformer 81774, and the field circuit of the loud speaker consists of a portion of the rectified circuit which supplies the plates of the tubes. In this circuit the loud speaker field also serves the giving of smoother rectified current to the plates.

Mr. Edwards: That is all on direct.

CROSS-EXAMINATION.

By Mr. Darby:

Q. Dr. Lee, how long have you been familiar with alternating currents? A. I studied alternating currents in 1907 before I went to college.

Q. And the same is true with respect to direct currents? A. I started to study direct currents about the some time.

Q. Now, the problem or the desirability in so far as actuating a loud speaker, such as in the Dunmore patent in suit is to supply the coil with direct current so as to prevent distortion or a noise to drown out the music or speech that is to be reproduced, is it not? A. Under the ideal condition there should not be any variation of either the armature or the field. However, in some of the rectifier devices that we use in conjunction with house currents there is always a small ripple or hum left which in this case exists both in the armature as well as in the field coil. The purpose of the invention shows how the effect of this residual current or hum current how it can be compensated for or avoided concerning the output of the speaker.

Q. The ideal condition is to supply the loud speaker with direct current without fluctuations, is that right? A. You are supplying the speaker in the armature entirely with alternating current. There is no direct current at all in the armature circuit of this speaker. Ideally in the field circuit, if you could supply direct current entirely to the field circuit, that condition would be ideal.

Q. And therefore, what the patent in suit is directed to is to overcome fluctuations which occur in the field due to the use of alternating current? A. The object of the invention is to use the fluctuations in the field and also the fluctuations which exist in the armature circuit, due to the fluctuations in the plate circuits, so as to compensate the effect of the armature and the field.

Q. How long have you been familiar with rectified alternating currents? A. Of course, I have been familiar with rectified alternating current ever since I was in college. That was 1911.

The Witness: It is very old to rectify alternating current to obtain direct current. That circuit is right old, the method of rectification.

Where you rectify alternating current, the rectified current that you obtain as a result is apt to have fluctuations.

As to how long I have been familiar with filters for smoothing out devices to eliminate those fluctuations or reduce them as far as possible, I will say that there has been issued some time ago a patent describing in varying detail by Hull, showing the method of filtering out fluctuations from rectified to alternating current sources. This is probably one of the first instances. The patent handed me is the one that I refer to, No. 1,251,377. This was applied for in December, 1915, and issued December 25, 1917. In addition there are other patents that were issued to Dr. Pupin, and rectifying the portions of the hum or ripple frequencies which come from sources of direct current, not batteries, such, for example, as would be considered a component of a direct current dynamo. These have also a certain amount of hum in them. The degree of hum which is permitted to go through those filters of the Hull type depend in large degree upon the dimensions of the constants in question. In other words, I could make a filter which does not filter very well, but still do some filtering, and I could keep on applying more energy and making the circuit constants larger and larger and larger, and eventually I could have a filter which would be 100 per cent filter, with a negligible hum.

Mr. Darby: I ask to have the patent referred to by the witness marked for identification.

(Patent referred to marked, "Defendants' Exhibit A", for identification.) (Defendant's Exhibit C.).

By Mr. Darby:

Q. Now, as you say, if you get a good enough filter, you can eliminate the hum by the filtering method, is that right? Is that what you just said in your last answer? A. If you make the capacity and the inductances in the system sufficiently large, which, of course, would make it very big and expensive, and would not be entirely necessary for a successful operation of ordinary sets, you can in the limit produce at great expense a filter which would be ideal.

Q. Then your answer to my question was yes? A. Under the question it is physically possible to do so, yes.

Q. And where you use filtering apparatus, inductances and capacities between the rectifying device and the field coil, that method of eliminating hum was referred

to in the prior trial on this patent as the method of prevention of hum, was it not?

Mr. Edwards: Well, now, I object to that. The record of the prior trial will speak for itself. Mr. Darby does not give any indication as to who referred to it, or why, or in what connection. It seems to me that is going rather far afield.

Mr. Darby: I have no ulterior point whatsoever, except I am trying to adopt the nomenclature of the prior case, so as to simplify discussion, simplify testimony.

The Court: I will allow the question.

The Witness: In the prior trial, I would need the records of the prior trial in order to give you an exact answer.

By Mr. Darby:

Q. Well, don't you know what the method of prevention means as applied to elimination of hum? A. If you refer to the circuit in the Hull patent, the output of the circuit is intended to give a uni-directional current the degree of variation which depends entirely upon the constants adopted in the circuit. In other words, there is always a fluctuation at the terminals of this circuit when current is drawn therefrom.

Q. Does the term, Method of Cure, mean anything to you? Does that refresh your recollection of this subject? A. Speaking of it in the art, you never use the word "cure" in any electrical system. I do not know just—I can not apply that in the technical terms of the art.

Q. Did you read the opinions of the Court of Appeals in those cases? A. I have not read the opinions of the Court of Appeals.

Q. Well, I suggested this to you, that in the patent in suit it is a fact, is it not, that no filters, such as inductances and capacities are included in the circuit from the rectifying device 14 and located between the rectifying device and the field coil 10, that is correct, isn't it? A. The field coil 10 itself is a rectifying device, being a large inductance.

Q. Will you please answer my question? A. There are no supplementary methods of rectifying the direct current between the coil 10 and the circuit in question.

Q. There are not any devices, are there? A. The inductance on secondary transformer 26 may be considered an inductance in that circuit which tends to keep the current steady.

Q. That is the transformer which feeds current to the circuit? A. That is right.

Q. And with that possible exception there is no filtering element included between the transformer and the field coil, is that correct? A. In the patent there is no other filtering action. On the other hand, the hum in this circuit would have been very much greater than the hum that would exist if the filtering action would take place. In other words, the patent operates effectively this way too.

Q. In other words, you would expect in the arrangement of the patent in suit that you would have a substantial hum in the circuit leading to the field coil 10, is that correct? A. There would be a very substantial hum if proper provisions were not made for correcting the phase reversals in the two circuits.

Q. And the provision made by the patent to overcome that, as you testified in direct examination, is to so arrange the coil 9 that it is in opposite phase to coil 10, is that correct? A. The arrangement is such that the current in coil 10 and the current in coil 9 would be such that if, for example, the current in coil 9 was increasing, the current in coil 10 would be decreasing, and the resultant effect would tend to neutralize the disturbance of both coil 9 and 10.

Q. So that in the arrangement of the patent you have fluctuations in the circuit of coil 9 and fluctuations in the circuit of coil 10, which, according to the patent, you balance out by so arranging those coils that they are out of phase with each other? A. So arranged with the curcent in the coils that they are out of phase with each other.

The Witness: Rectifier 14 is a half wave rectifier. It rectifies only the current in one direction of the alternating current supply.

Alternating current is current which first is negative, and starts from zero, first becomes negative and then goes back to zero, and then becomes positive, and so on. A half wave rectifier will rectify only the negative current or only the positive current.

Q. So that in a half wave rectifier the current that you obtain as a result is—assuming, for my point, that you are just supplying the negative current—the current that you get as a result, which is direct, is, in effect, and layman's language, is a little bit of negative current, then an empty space, then some more negative current, then empty space, and some other negative? A. All that would hold true if there was not anything else in the circuit except the rectifier. However, in this circuit you have the inductance coil——

Mr. Darby: I think the witness ought to answer my question.

The Court: Go ahead.

Mr. Darby: If it has anything to do with my question I have no objection. But he is going ahead of my question.

The Court: He evidently thinks it does. Go ahead.

The Witness: You have not stated your circuit completely. If you will state your circuit completely, I can answer you.

By Mr. Darby:

Q. All right, I am merely trying to give a graphic picture in non-technical language of the resulting rectified current secured by a half wave rectifier. A. On what kind of a circuit?

Q. Any kind. A. The circuit must be complete.

Q. Any kind of a circuit? A. Well, by circuit you have a capacity or inductance or resistance in it, or various combinations.

Q. All right. A. Do you want to make your resistance, for example, or inductance, or what kind of a circuit?

Q. Let us have a plain copper wire circuit. A. Plain copper wire will have resistance and inductance, if you like, back of it that way.

Q. All right. Is my graphic picture correct? A. Your graphic picture leads to error.

Q. You give me a graphic picture. I merely want to bring to the Court in layman's language what it is. I do not want to be technical. I want to bring to the Court

what is the result of half wave rectification of an alternating current? A. In a half wave rectification the energy component or the voltage which sends the current through the wire is only applied to the circuit from one-half the cycle. The current which flows because of that impulse of voltage depends entirely upon the character of the circuit upon which the voltage was impressed.

Q. Well, choose your own type of circuit, and draw me a picture, will you, in non-technical language, first of pulsating current, which flows a little while, and then stops, and then flows a little while. A. It is the pulsating current which may increase while the applied energy is there, and which when the applied energy is removed, it decreases again. Whether this decreases to zero or not depends upon the circuit.

Q. But there is a gap between the pulses which is represented by the other half of the alternating current that has not been rectified, is that correct? A. The interval betwe-n the pulses in that which has not been rectified is of the half—is of the time of a half a cycle, if that will help you any.

Q. Will you, doctor, tell me a simple illustration——

The Court: Well, now, I was coming to that myself, if I can interrupt. Doctor Lee has no doubt tried, and every one here has tried, to make this matter clear to me. And I take all responsibility for it not having been made clear. Frankly, I am just about as much involved as I was before, when you started. That is no reflection upon the efforts that have been made. Now, this thought occurs to me, and I would like to ask Dr. Lee whether this is possible—Mr. Edwards said that the matter was very simple when he started out, and it would not take but a little while to cover it. Isn't it possible, Dr. Lee, for you to take, say, that blackboard and just assume that I am the lowest form of student that you had or may have in a course in Johns Hopkins; isn't it possible for you to draw a diagram on that board, and, after you have drawn it, trace the course of the current at the time it comes out of the coil, through the various coils or rectifiers, or what not, the way it goes, and describe what it does, and how it eliminates this hum in the patent; and then draw a corresponding drawing of the alleged infringing device, and show me how the current comes in and what happens to it in there. I do not know

whether that is possible; but if it is not possible, unless the two machines are set side by side—and I understand you have not got them here, that is correct, isn't it?

Mr. Darby: That is my understanding.

The Court: When I say these two machines, I mean the two set-ups. Unless what I suggest is possible, I am frank to say I do not think I can get any comprehensive layman's understanding of what this is, but if it is possible, go to the board, or a larger board, if that is not big enough, and draw this thing——

Mr. Darby: I was going to do that very thing by simple drawings with the witness under cross-examination.

The Court: Well, the advantage of this is I can visualize it. What I want to see is—I want you to demonstrate the current running through each of these devices. Now, that is the problem, isn't it, to determine how it goes and why in going that way a certain thing happens to it. Isn't that the question?

Mr. Darby: That is the question, if your Honor please; but, you see, the difficulty is, they do not use—nobody else uses this thing on the patent. That is the reason why they have no model of it. They can not put any apparatus side by side with a commercial apparatus.

The Court: Well, Dr. Lee intimates, at least, that he can make two drawings side by side. If you bring that out just a little further I can see it better.

The Witness: Can you see that, your Honor?

The Court: That is all right.

The Witness: (At the blackboard) We will take first the patent drawing. The ordinary transformer consists of primary winding, which is wound around an iron core, and a secondary winding; the voltage applied to the primary winding is transformed in the ratio of the number of turns to the secondary winding, which may be considered the source of voltage or power. I am going to draw it diagramatically this way (drawing diagram). There is the primary winding. This is usually the house supply, 110 volts.

The Court: Is that where the current starts in?

The Witness: That is where the power starts in, the current start in. Then this core of the transformer offers a very convenient way of getting the voltages at various—you get to the coils various voltages here. You may want to put a small coil on here and get a small voltage by just putting a few turns there. If you want very high voltage, you put a great number of turns on there. Now, in this diagram of the patent, I think he has one, two, three, four, five, six—six different windings, one of which is the primary, and each of the separate other windings are designed to give the proper voltages for the circuits which they want to operate upon. Now, we are interested in a vacuum tube or rectifier device, which consists of a heating element, an element which has to be heated, and this element that is to be heated is generally of very low voltage, of the order of one or two volts; so we will put a little winding on there and supply this with the proper heating current.

The Court: Now, in a word, what is this, what is the theory of that?

The Witness: This heating current activates a tungsten wire. Now, when tungsten wire gets red hot or white hot, it has a property of emitting negative particles in all directions from it; and this, therefore, can be made a portion of another circuit in such a way that if you would take another element in there—in this case connected two together—if you would connect this together, that wire current would only flow when it could take the advantage of the negative charges of the electrons; as soon as the negative charges flow up through, then the current can flow through. That is, while this side is positive and this side is negative, the current will flow, being one-half of the alternation. In other words, the voltage applied here and here may be considered a battery, and at one portion of the time it is in this direction, which we call a positive direction, and the next portion of the time, when its polarity is reversed, then this becomes negative and that positive, and the current tends to flow in the reverse direction. While the potential is in this direction, the current can flow; when it is in the reverse direction no current flows in the circuit. Now, if you take this portion of the circuit and connect

it to a coil of this nature, then it is like applying force to a big mass; you may apply force for some time before you can get the thing to move. So the current does not immediately begin to flow proportionally to the pressure you put on there, which we consider voltage, but it drags behind it; and if they are in a negative portion of the cycle, it kind of sloughs—in other words, you have got pulsations in it, which you may call current in that circuit; and that current tends to keep flowing, although it may drop off—the degree which it drops off depends entirely on what the resistance in the other constants of the circuits is. It may go down to zero, and then have in this interval no current, and then later on it may repeat itself; or you may have a sufficiently high inductance that at once it may carry itself over into this phase and then come back again, and go on, which you may call a pulsating current, always in the same direction, but not of constant amplitude; in other words, the current strength changes a little bit, but it is always in the same direction, which is called a pulsating current. This you can consider the primary or the field of the speaker. Now——

The Court: Now, why do you call it that?

The Witness: Well, the reason for calling it the field is because of the construction of this speaker. If you take the speaker, it looks something like this (drawing diagram), this is iron. And if you look at it from the top—if you will pardon me——

Mr. Edwards: Don't rub that out, doctor, because I want to offer this sketch in evidence——

The Witness: I have just moved it back.

Mr. Edwards: —or a copy of it.

The Witness: I believe if you view it from the top—this is round—let me draw it again, your Honor, because it is a little confusing.

(Drawing diagram).

This section here we consider, this portion in here, this is iron. Now, there is an air gap in here and in this air gap is placed the coil which we call the armature coil. Now, the winding itself is wound in here in the form of

a big coil which fills the whole space here (indicating). In other words, this is just a coil wound around this iron step on the inside, and when this coil is energized there is a magnetic field which goes across this gap. I am going to enlarge that gap a little bit because that is the whole trick of the thing. Here is the field across the gap, the magnetic field. The current which energizes it, comes from this winding in here. When the current flows in one direction through here——

The Court: Where is that on the diagram?

A. On this diagram, your Honor?

Q. No, on the other one. (A. That is just marked diagrammatically by this coil (indicating). All of this coil really signifies this system. I say, under the ideal conditions, when the current—if you can have direct current through here (indicating) this field here would be absolutely constant, it would not change. However, if you put a pulsating current in here (indicating), there would be sometimes when the field would be getting a little bit stronger when the current was in that direction—I am going to draw the wave of the current again—when the current comes to a maximum in this direction it begins to get a little the best, then its strength becomes a little less—the magnetic field is exactly apportioned to the current which we are applying to this interval which we call the air gap. In this air gap there is a transformer winding. If the current flows through this winding and it is in the magnetic field, the force which acts on there to move it up or down, depending upon what the direction of the current in this armature winding is, depends upon how strong this field is and how big that current is. What they generally do is to take this coil and mount it on a receiving system and affix it to a cone so that this thing is solid now, and as the current changes up and down this whole cone is vibrated up and down and transmits this force onto the diaphragm. When the current is in a pulsating direction in here (indicating), the direction will force it up, when it is in the other direction the force is down.

The Court: Can't you go ahead now on your small diagram and finish that out?

The Witness: May I rub this off of the blackboard?

Mr. Edwards: I would like to offer these diagrams referred to by the witness in evidence and, with the consent of counsel, make a copy of them so that the record, the testimony of the witness, can be followed with this diagram.

Mr. Darby: It is perfectly agreeable, but, to save time, I suggest that we turn this around and use the other side.

The Court: That is doing just what I do not want done——

Mr. Darby: I am sorry, your Honor?

The Court: —because I am trying to get a complete picture of the whole thing.

Mr. Darby: I am sorry.

The Court: I do not yet know how far you have gone. Where are you now?

Q. Where does the sound come in? A. The sound is not shown in this circuit. With your permission I will introduce it now. I will have to take a little bit off of this circuit.

Mr. Edwards: May I offer in evidence the diagram made by the witness on the blackboard?

The Court: You can not do that now, because it has to be copied.

Mr. Edwards: By consent of counsel we will substitute a copy of the blackboard copy.

The Court: He can redraw that again. I want him to finish the drawing and show me how the sound comes in and show how the current affects it.

Mr. Edwards: May he not do that on the other side?

The Court: I do not think so because I will be looking at two things. I want to see this all together.

The Witness: If I can rub this off here?

The Court: Yes.

Mr. Edwards: May he substitute another drawing later on?

The Court: Yes, he can draw it again.

The Witness: Now, we also have connected to this transformer a vacuum tube, or amplifier circuit. Now, that consists of three portions: One portion we will call the filament; the other portion is, you might say, a throttle or control and the third portion is a plate. Now, this portion of the circuit is very similar to this (indicating). In other words, this is heated by a source of energy, that source of energy is also taken off of this transformer, so we can heat that tube and bring it into condition. Then there is a signal that we say comes into this grid which changes the voltage, the pressure between the grid in this tube—in other words, as the negative electrons come out here—if you make this grid negative it will keep some of them from coming out, if you make this grid more negative it will keep more of them from coming out, and if you make it less negative it will keep less of them from coming out, and, therefore, the current which passes this grid depends upon how that grid is operated upon. Actually, you have to be careful in a condition of this kind that you do not, if you operate on alternating current, that you do not connect the grid—you put a battery in here in order to make that grid negative and now you put a source of transformer in here where the signal is applied to that grid. Now, this is normal (indicating). This grid with respect to that filament is normally negative, but it can be more negative or less negative, depending upon whether this signal is positive or negative or negative or positive, and in that way it changes the potential on the grid proportionately to the signal. Now, in this circuit there must be a potential positive with reference to the grid. That also has to come from this rectifying device. What we do in that case is to put out another rectifier very much like this one. In this case these two points connect together.

Mr. Edwards: Hadn't you better draw a circle around that in order to show it is a tube?

A. This is a tube. In other words, this whole system is evacuated in a glass tube, otherwise you would not get the phenomena of negative electrons coming out of the filament. In this circuit you have got to have a source of potential between this point (indicating) and

this point (indicating) and you have got to get it from this transformer, so they usually have a winding in here which is connected between the two, but you put a condenser in here (indicating), so that when this is positive, when this winding from this transformer here which makes this positive, the current can flow through. In other words, this becomes charged positive and when the current reverses the electrons do not flow through from the other side. In other words, it begins to charge that condenser a definite potential because the current can only flow into that condenser when this is positive, but it can not when it is negative because the electrons do not flow in the reverse direction. So, therefore, this condenser can become a source of energy to supply this plate. The positive part of the plate should go there (indicating) and the negative portion of the plate should go here (indicating). Now, if this condenser is big enough and this source of energy in this tube is large enough, you can put enough charge in here that during the interval in them you have no alternating current—that condenser serves as a source of energy to keep this current going, but due to the fact that this is pulsating, the energy of this circuit, or the current in this circuit is also pulsating, this pulsation, if you put a transformer in here (indicating) can be transmitted very much like this transformer over here, you have audio frequency from the signal coming in and audio frequency going out, only that the tube has strengthened this signal and put more energy in here than is supplied here (indicating). Now, this pulsation which goes on here goes on here due to the rectifier system. You have a condenser in here (indicating) and that condenser gives you the energy during the interval at which no energy can be supplied through this rectified circuit. That is a pulsation that goes on there (indicating). Now, this secondary transfers the energy here (indicating) into the armature circuit into this circuit here (indicating).

The Court: That is what you had up at the top of your drawing?

A. Yes, the same as this (indicating). In other words, it would go to this coil in here. In other words, I have the same coil.

Q. I noticed there is a little one up at the top? A. This?

Q. That. A. This coil in here is this field coil here (indicating), your Honor.

Q. You do not need the one, then, you have got your finger on, do you, to show me the connection? A. May I connect this up to there?

The Court: All right.

Q. That is the loud speaker, isn't it? A. Yes. There is a coil resting in here (indicating), that is a circular coil that is in that air gap. Now, you have a pulsation in this circuit due to this rectifying system and you get a pulsation in this circuit due to this rectifying system, which has nothing to do with the incoming signal at all. In other words, it is an objectionable condition. Now, the art teaches that if the impulse through this circuit, or on here (indicating) and the impulse from this system (indicating) are so directed that as this impulse becomes greater this impulse becomes weaker, we get the resultant action that shows the uniform effect but does not show the effect of each.

Q. Can't you state that a little differently and put your finger on what is supposed to be the novelty in that set-up? A. The novelty of the set-up is this—may I draw another diagram?

The Court: We will not have time this afternoon for that.

The Witness: The current in the armature circuit is here (indicating) and the current in the field circuit is here (indicating), so the resultant force of the two is zero.

Q. (By Mr. Edwards) You spoke of the art teaching you that if these coils are connected in a certain manner —what art are you referring to? A. I am referring to the——

Q. What art teaches you that? You spoke of the art teaching you that if these coils are connected in a certain manner—— A. The theory of the patent teaches you that is the case.

The Court: We will go on tomorrow morning at eleven o'clock.

The Witness: I am sorry, your Honor, I could not put it down in a little shorter space than that.

The Court: Tomorrow, I want you to explain to me again, in even more monosyllabic terms, where the novelty lies. I see the diagram now, but I do not see the novelty. We will go on at eleven o'clock. Maybe I can see it better tomorrow.

(Examination of witness suspended.)

(Thereupon, at 4:10 p. m., an adjournment was taken until 11 o'clock tomorrow morning, June 15, 1934.)

Baltimore, Maryland, June 15, 1934.

THIRD DAY.

(Present: Counsel for the respective parties).

Dr. Frederick W. Lee, resumed.

REDIRECT EXAMINATION.

By Mr. Edwards:

The Witness: Yesterday I made some diagrams on the blackboard and gave an explanation. In order to enable that to be followed, to some extent, I have made a sketch substantially reproducing what was put upon the blackboard. The sketch represented by Figure A is substantially the sketch represented on the blackboard.

In that sketch the input is marked in green at point "input" on the green circuit. There is only one green circuit on this sketch. That is where the signal goes in. The power supply input of the usual alternating current house supply is at points 27 and 28, and the primary of the transformer is marked 24. The filament circuits are all colored with a red pencil. They receive their current also from the common transformer. The kind of current in these red circuits is what is known as raw alternating current. That is current of the exact nature that is supplied at points 27 and 28.

The plate circuit of the output tube 7 gets its circuit from a transformer winding 21, which is connected through a rectifier tube 18, and then to a condenser 16, in series with an inductance 17. The plate voltage is

taken from the terminals of the condenser 16. The current in that plate circuit is of a pulsating nature, which may be defined as being a unidirectional value, but its amplitude may vary slightly at pulsating or uniform intervals. In other words, that is rectified current, consisting of a series of uni-directional impulses.

The circuit from the transformer, 8, to the coil, 9, contains pure alternating current, and it is not pulsating current. That coil 9 is the coil on the speaker that vibrates with the rise and fall of the current in that circuit. The coil, 10, gets its current from the transformer winding 26, which is fed through the rectifier, 14. It is also pulsating in nature. As to what happens to that pulsating current when it goes through the coil, 10, I will say that the coil, 10, tends to smooth out the pulsations.

In the operation of that device, assumed that the coil 8 is wound in the same direction that the coil 10 is wound in, the effect that has upon the operation of the loud speaker is as follows: The pulsations are applied to the cone so as to strengthen the effect of the pulsation in each circuit. That is, the pulsation in one coil aids the effect of the pulsation in the other. As to what is the effect on the loud speaker, if the coil, 9, is wound in one direction and the coil 10 is wound in the opposite direction, I will say that the pulsations are in opposition, and tend to oppose each other, and therefore annul the forces upon the diaphragm of the loud speaker.

So far, I have been considering the operation without any signal coming in. Now, assuming that a signal is applied to the input of the tube 7, and assuming that the coils 9 and 10 are wound in the same direction, then in that case the diaphragm vibrates, due to the cumulative effect of the pulses, and also due to the input signal strength, so as to combine the vibration of both. The signal is distorted. Now, still assuming that the signal is coming in, and assuming when these coils 9 and 10 are wound in opposite directions, the effect on the signal is that the pulsating effects and the distorting effects are balanced out, and the signal comes through without distortion.

The Court: Now, I would like to ask Dr. Lee right there. I have this sketch here (indicating).

Mr. Edwards: Yes.

The Court: Can you put your finger on what you claim to be the real novelty in this combination?

The Witness: The novelty of the invention to my mind consists in using the loud speaker.

The Court: The loud speaker is down there between 10——

The Witness: 9 and 10.

The Court: 9 and 10.

The Witness: Using the loud speaker to eliminate some of the hum from the alternating current source. The novelty consists in using two systems, that is, the coils 9 and 10, which tends to balance out the noise, and, at the same time, not cause any distortion from the actual signal that is supposed to be reproduced by the loud speaker.

The Court: Now, then, in simple terms, how is that done? You have said that is the novelty. Now, just how is it done in A, B, C language? You can not do that, though, without going all the way back over it?

The Witness: I do not want to go back to that, your Honor. I just want to give you the effect in the diaphragm itself. If analyzed into its ultimate value, you will have a force which is applied to the diaphragm of the speaker. If this force is of an alternating nature, the diaphragm vibrates, and that produces sound. Now, the cause of this force from the electrical portion of the circuit comes from two sources; one is the magnetic field and the other is the current in that magnetic field. The magnetic field is supplied by circuit 10. And the current in the magnetic field is supplied by current 9. It teaches that if, for example, the current in 9 is gradually increasing, due to pulsation, we would decrease the field by letting current 10 drop off a little bit, just to compensate that increase of current by decreasing the strength of the field, and therefore reduce the force on the diaphragm to nothing. That boils it down to its last common denominator.

Q. (By Mr. Edwards) Let me interrupt you a moment and ask you this question, Doctor, Let us assume that

the field 10 is of constant strength, receiving current, for example, from a battery. Now, the signal comes in in the coil 9. Now, what does that signal current flowing through coil 9 cause the coil 9 to do? A. The coil 9 vibrates proportional to the signal strength. Coil 9 is attached to the diaphragm of the speaker. And the signal current flowing through the coil 9 tends to move that diaphragm proportional to its value.

The Witness: If we assume that there happens to be a constant current flowing through coil 9, and a varying current through coil 10. That would give you the same effect; in other words, it makes no difference if you keep the coil 9 constant and vary the strength of the field by current 10, and get a variable force applied to the cone of the speaker. As to whether that is equivalent to saying that when the signal energy flows through coil 9, it tends to move the diaphragm of the speaker, and when varying energy flows through coil 10 it varies the field, and that also tends to move the diaphragm, I will say that you have the force upon the diaphragm dependent upon two factors, that is, the signal in 10 and the signal in 9, if you like to think of it in that way.

Now if you assume the signal of 9 only, and an alternating current or a pulsating current in 10. Then you have a varying current in 9 and a varying field, magnetic field, caused by a variation of current in coil 10. Then you get a combined effect of the two. If those two coils are wound in the same direction—then the combined effect is such as to aid the effect of the two pulsations in 9 and 10 and both work to move the diaphragm, with the forces in the same direction upon the diaphragm. When the coils are wound opposite, then the effect on the diaphragm is that the forces are in opposition, and there is no movement of the diaphragm.

Mr. Edwards: I will offer this diagram in evidence, and ask to have it marked "Plaintiffs' Exhibit No. 96."

(Diagram referred to marked "Plaintiffs' Exhibit No. 96.")

The Witness: I was also asked some question as to the difference between a full wave and a half wave rectifier. I will state in single terms just what that difference is. A full wave rectifier takes the raw alternating cur-

rent, and at every half-cycle, instead of permitting it to flow in the opposite direction, as it normally does, it flows in the same direction as it had in the previous cycle, while in the half-rectification, the second half of the cycle is not taken into consideration at all. In other words, there is no application of energy to the system from the second half of the cycle. As to whether the full wave is merely two half-wave rectifiers, and, therefore, has twice as many uni-directional impulses as the single wave rectifier, I will say that in the 60-cycle circuit, in the half-wave rectifier, you would only get sixty impulses a second, while with a full wave rectifier in the circuit, you would have 120 impulses a second. Both of them would act in the circuit in the same direction.

I have referred in my testimony to constants of the circuits. Constants in electrical circuits are generally referred to as resistances, inductances or capacities or combinations of them. A condenser is a capacity and a coil is an inductance.

Mr. Edwards: That is all.

Mr. Darby: No cross.

(Examination of witness concluded.)

Thereupon FRANCIS W. DUNMORE, a witness of lawful age, produced on behalf of the plaintiffs, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Brady:

The Witness: I am the co-inventor with Percival D. Lowell, named in Letters Patent 1606212. I can produce records which tend to establish the time Lowell and I made this invention. There is a copy of my notebook which I kept at the Bureau of Standards, and on page 57 of this notebook is a complete circuit diagram in invention showing the full circuit arrangement under date of January 20, 1922. We actually built and constructed the circuit arrangement shown in my notebook. We had this circuit set up in the laboratory and operating at this time.

Mr. Darby: Mr. Brady, may I ask if it is the purpose of this witness to establish the date of invention?

Mr. Brady: Do you concede the date of invention?

Mr. Darby: Will you answer my question, please?

Mr. Brady.: We wish to show how this invention was made and the developments from the date of the invention and the commercial use of the invention.

Mr. Darby: I thought I could save time if all the witness is produced for is to establish his date. I am willing to accept his date as stated if that will dispense with the necessity of the testimony.

Mr. Brady: That will shorten it considerably. Thank you, sir.

Mr. Darby: That is, for the purpose of this case.

Mr. Brady: When and to whom did you disclose your joint invention?

The Witness: This invention was disclosed on this date to Morris Strock, Mr. Francis Engle, Mr. Robert Kruse and others in the laboratory who were working there at that time.

Mr. Edwards: Is it clear that it is admitted this invention was completed on January 20, 1922, for the purposes of this case?

Mr. Darby: For the purposes of this case, if you do not ask him any more questions about it, but if you are going ahead and prove it anyhow there is no sense in the concession. I am making the concession to save time, frankly.

Mr. Edwards: I want to know if you will make the concession or not?

Mr. Darby: I make the concession if you are not going to prove it.

Mr. Brady: We have not followed that particular phase of it. I am asking now the advantage of the invention.

The Court: May I interrupt here? Perhaps, if I step down to that thing, by touching the parts you can make it as clear as anybody else.

Mr. Brady: That is a good suggestion, your Honor.

(Court leaves the bench).

By the Court:

Q. Do I understand this is set up the way the drawing is? A. This is defendant's apparatus but it is typical of what we have.

Q. And do you claim this is your apparatus? A. Yes, this is the loud speaker——

Q. But it does not follow the drawings in the patent? A. Yes, it does, substantially.

Q. But I could not take the drawing and match each part, that is what I mean? A. No, sir.

Q. Very well. If you will just start, as I said to Dr. Lee, assuming that I have absolutely no intelligence at all on this subject, suppose you were trying to explain to a child how the current comes in and how the voice comes in.

Mr. Edwards: Your Honor, let him point out on that instrument parts corresponding to the exhibit.

The Court: All that exhibit is, is a copy of what is in the patent drawing.

Mr. Edwards: It is the defendant's apparatus. It is a copy of the photostat admitted by the defendant to represent the circuit of this apparatus, and we contend that the portion indicated by a cone there is the loud speaker and the two circuits are present in that diagram, and Mr. Dunmore can point out those circuits.

A. To get down to the fundamental part of the invention that involved the output part of this, this part here is the part of the radio set that picks up the weak signal from the antenna or wire that is strung up in the air and amplifies it so that it comes out from the output of this unit here with sufficient volume to operate this loud speaker device.

By the Court:

Q. Which is this (indicating.) A. Which is this device here (indicating.) This part here is the cone part

that produces the motion of the air that makes the sound you hear and is shown on the diagram. The diaphragm on the circuit is 81274, which is this parchment here. Now, attached to that parchment——

The Court: Wouldn't it be better to start and just take the voice coming through first?

A. I tried to make it simple and jumped over that part of it because the invention is not involved there. This, here is a radio receiver merely used to step the voice up so that it can be put into this device and produce sound. If you like I can go into the details, but it is not necessary, as I see it, for you to understand this operation. This is nothing but an amplifying device.

Q. You mean what Dr. Lee is talking about is down here, then? A. Principally, is right in here (indicating), and back here (indicating).

Q. Well, he has been talking about all of these various coils. Where are they? A. I am about to show them to you back here (indicating)—some of them. The condensers are under here (indicating).

Mr. Edwards: I think, Mr. Dunmore, the coil feeding the signal energy to the loud speaker is indicated on that in brown and that is coupled to a circuit that comes from the tube marked 2A5. Can you find that tube 2A5 in this set?

A. Yes, sir.

Q. And show where that circuit comes from the set. A. For this purpose I will say that this is the output tube that I have my finger on. In other words, this tube here represents 2A5 in the drawing. Now, that tube——

Q. Now, there is a circuit from that plate circuit? A. There is a circuit from that plate circuit shown in yellow here. From this tube the current, from that tube which contains the signal you are going to hear ultimately out through the loud speaker, flows through this transformer.

Q. Can you find that circuit in this set? A. Well, there is the transformer (indicating). This is the transformer, 81774. That transformer is probably, I think, this one under here (indicating), this one I have my finger on.

By the Court:

Q. Which one is that? A. This one here in the base of the set.

By Mr. Edwards:

Q. Down in the base of the set in the upper left-hand corner viewed from the top of the set? A. Yes. Now, the secondary of that transformer is shown in black.

The Court: This is not helping me any. Let us abandon this whole line and just you tell me—leave this aside for the present—tell me, as I said, suppose you had somebody who did not know anything about electricity, or a radio, now, isn't it possible to explain to him what the novelty is?

A. Yes. I will try my best.

Q. Let us leave out all reference to numbers and diagrams and everything else and just suppose you were trying to explain to somebody with no prior knowledge of electricity or radio what the alleged novelty is. A. All right, sir. This cone, which produces the sound in the air, is caused to vibrate by two forces: One force, which is the force that gives the sound in the music, and the other force which is due to the alternating current that comes out of this set and goes into this loud speaker. Now, we do not want to hear that alternating current so we have to use means to keep that from coming out as a hum to distort and spoil the music, so that in order to do that, since there is bound to be some of that hum get into this loud speaker, because it is almost impossible to keep it out, we devised a means of so connecting the two parts of this speaker that they operate, as far as the hum is concerned, in opposition so that there are two forces pushing in the same direction on something which is this cone and the cone can not move, therefore it can not produce any sound of that hum, therefore the hum, as far as the hum goes, there is no sound in the air. But there is no bucking effect; as far as the music goes, that comes out clear and pure, so we do not want that hum and we found means of getting rid of it, not in the set itself, but in the speaker by this opposing phenomena. You may think of two steam engines trying to work in opposition to turn a crank shaft, and if they pushed at

the same time, and pushed in the same direction the shaft would not move. That would be the case of the two hums in here opposing each other, whereas, if they do not work properly and get aiding each other they will come out as loud, as a loud hum, which will distort the signal. It comes right down to not the radio set but the particular way that the speaker is connected, and Mr. Lowell will bring out further features of that.

The Court: You can not explain that to me now by looking at it,—in other words, you say all this can be ignored, practically?

A. As far as your need for understanding the invention is concerned, this is nothing but a device to take the little weak signal that comes in on this wire, which has half of mosquito power and boosts it way up to watts. Well, considerable power that you get here. It is an amplifying device and for the purpose of understanding the invention, as I see it, it is not necessary for you to know this.

Q. This is done, in layman's language, by running it through here (indicating) and by passing alternating current through it? A. Passing alternating current through it, yes, but in order to get energy out of anything and boost it up, you must apply energy. You can not get something for nothing. Now, if this is coming in very weak and you want to boost it up you can supply energy from some source to boost it. That source is this alternating current that is in the house alternating circuit. Alternating current is a very bad current as far as the ear is concerned because it makes an audible range, and when you put it in the tubes it goes into the circuit and comes out here (indicating) and you hear a hum because it is not smooth direct current. It is continually reversing so it is bad to use for this purpose, but it is available in all homes and that is why we use it.

Q. Do I understand you to say that a large part of what is on this Stewart Warner Plaintiffs' Exhibit 95, which represents this (indicating)——

A. All of this here (indicating).

Q. —that according to you that can be ignored? A. I say that for the purpose of making it simple for you

it can be, but it can not be ignored because the hum comes into this circuit.

Q. For the purpose of determining whether or not there is any novelty in the patent I understood you to say it can be ignored? A. Not entirely. I do not mean that because the fact is some hum comes in here and it is that hum that comes in that we make use of, so we can not ignore it entirely. If this (indicating) was not here (indicating), of course, we would not have the invention.

Q. Do I understand you to say you can set this up—do you claim any novelty in the way this is set up? A. No, sir.

Q. And the way this section is set up? A. No, sir.

Mr. Edwards: Not as to this particular patent.

A. On our other patent, yes.

The Court: Then we do not need to talk about it?

A. We do because in a set like this, because any set like this delivers some hum besides the signal, so we have to consider that this is not delivering pure signal.

Q. I understand that, but for the purposes of this case I understood you to say, that you admit that the hum, in lesser or greater degree comes out of any set-up like this? A. Yes, sir. There is some hum that will come out of any set-up like this.

Q. You are not trying to improve on the art there at all (indicating); you are trying to improve here (indicating)? A. Yes, sir.

Q. Then why isn't it a fact that while it is desirable to understand this (indicating), it is not necessary to understand it for the purpose of this novelty in this patent? A. It is not necessary if you will understand that there is some hum that comes out of here (indicating).

Q. We assume that because then you would not have any problem? A. Yes, and it is true because it would be very expensive to build this set so it would not give any hum. That is why we worked out this device so sets could be made cheaper and the cheaper the more hum they will deliver.

Q. You make your device in order to alleviate the conditions of a hum set? A. Yes, sir. This device is sup-

posed to give you good speech and music when a set is put on it that gives some hum in its output.

Q. And this may be of a number of varieties or types, this set here? A. Yes, sir, working from alternating current.

Q. And as long as it gave a hum then you say that the novelty lies in here, in that it decreases or removes it entirely? A. Removes it, yes, sir.

Q. Still I want to get that perfectly clear because it is bad enough to have to understand this (indicating), but, after all, if all this can be eliminated, so far as this patent is concerned—this is the only patent we are now talking about—— A. Yes, sir.

Q. —well, I would like to understand more about this, but it is confusing now to ask me to do it. A. Yes, sir. I have not described this (indicating).

Q. No, I wanted to get that perfectly clear. Now, a good deal of talk yesterday was concerned with this (indicating), as I understand it. A. Yes, it was. The rectifier is involved in here and, of course, that is what produces more or less of the hum. The perfection with which that is built, that is what we have been talking about here, the rectifier, that is this tube here (indicating), that is the tube that does the rectifying action——

Q. It does not make any difference, I understand you to say, whether that kind of a tube or some other kind of tube is used as long as you get the hum when it comes out here (indicating), isn't that true? A. Well, you must have a tube which has the function of the rectifier tube in the set. That is, you must take this alternating current and change it to direct pulsating current.

Q. Suppose, without knowing anything about this instrument, alleged invention of yours, I went down town this afternoon and bought a set and it had tubes in it, it was a modern type of invention, then I met you and you asked me what kind I had bought and I told you, and you said, "Well, that set has a hum in it, hasn't it?" I said, "I do not know whether it has or not", and you looked at it and you would say from your knowledge that it would hum. Then you would say to me, "Well, I have an invention that will remove the hum and that is this (indicating)", so it would not matter what kind of set I showed you as long as it was a humming set, would it? These questions may or may not be foolish questions,

but I understand you said you could set up any kind of a rig like this, provided it performed substantially this function? A. Yes.

Q. And that you are not claiming any invention for this (indicating)? A. No. The invention lies in this part (indicating).

Q. And in nothing in here, either (indicating)? A. No, sir, that is just for demonstrating purposes to show the effect of the invention. You did not hear this the other day, but it shows the result of what the invention accomplishes, how there is a hum and how the invention cuts it out.

Q. To take a perfectly simple simile, as I understand it, you are saying in effect the same thing that a man would say if he had some kind of a contrivance to keep a horse, we will say, from pulling when you rode him or drove him. Now, he would say to you, "All you need to do is to bring me a pulling horse, I have got a bit or a bridle that will, in my opinion, stop him from pulling or lessen the amount that he pulls. I do not care whether it is a black horse or a brown horse or a white horse or how old the horse is or how wild he is or how tame he is, but as long as he pulls this bit of mine is calculated to apply to his mouth." Now, I understand you to say that you do not care how they get the particular form that they produce the hum by, as long as it is produced? A. Just so the horse will pull, then you can apply the invention to it. Of course, this is a little bit more complicated than your illustration.

Q. I do not think that makes any difference. A. But the effect is there.

Q. You say then finally that as long as you get the common hum out of one of these machines, whatever type it is, you have no concern with how that is produced, but merely with an attempt to stop it? A. Yes, sir. We can apply our invention——

Q. That, it seems to me, simplifies the situation very much and I do not see any need of controverting that. Is there any need of that if the owner of the patent himself says that is a fact, if that is all he is claiming, then that is all I am interested in.

Mr. Edwards: I think that is quite true, your Honor, except you have come just almost to what the man is saying if you will permit me to say this for him, that

if you operate that set with direct current you will have no problem in the operation of your loud speaker.

The Court: That is conceded by you. It says in the patent, "For household use", where you have alternating current?

A. Yes, sir.

Mr. Edwards: And if they use an alternating current you will get a hum in two circuits coming from this part (indicating) to this speaker and, his idea, or the joint idea, is in the speaker itself, that if you will reverse these coils in the speaker instead of putting them cumulatively, you will avoid the effect of that hum in the speaker and the hum won't interfere with your signal.

The Court: He has not explained his invention yet. You have not got it up to that point?

A. No, sir.

Q. Now, then, that being true, if all the other testimony would concede, as a preface to any statement——

The witness: Just so you understand there are two circuits coming out of here, both of which have hums, or, rather, one of which has—yes, both of them.

By the Court:

Q. And you produce the two circuits by rectifying an alternating into a direct current by these tubes and other devices? A. Pulsating direct current, not perfect direct current.

Q. Now, then, explain the invention. A. This diaphragm which produces the sound in the air has a little fine coil wound on the cylindrical piece of cardboard that is shown next to that cone and is attached to that cone so that when the coil moves the cone moves, and it is in that coil that the radio signal is put and also some of the hum that comes out of this set goes in there, too. Now, that is free to move. Now, that is made to move by this big coil here.

Q. Can't you open this and let me see it? A. It is a big coil wound on an iron coil.

Q. Can't you open that up? A. Yes, I will try to. And that is 81779.

Mr. Brady: If your Honor pleases, you can see the little coil right through here.

The Witness: The Court wants to see the big coil.

The Court: You will have to take it out here. Here are the bolts.

The Witness: We can try it any way, your Honor.

The Witness: It has another coil of wire.

The Court: This coil all runs around in here?

The Witness: Yes.

Mr. Brady: May I ask the witness if this diagram would help him any in his demonstration (handing diagram to witness).

The Witness: Probably it would. You see, that field winding has a lot of turns of wire, and when it is excited and electricity acts magnetically on this little coil here that I have already pointed out on this diagram, the moving coil——

The Court: You mean makes it jump?

The Witness: Makes it jump back and forth, by the frequency of the sound that you hear, so that when that coil jumps this cone is attached to it, so it has to jump; and, of course, when a thing moves in the air it makes a sound, so it produces the music. This here is merely an exciting coil. This is the voice coil. This moving coil is the moving coil, and the speech, the voice, comes in that coil. It won't move unless there is energy in it; that coil won't move without some electricity going through it, no matter how much electricity you put in this coil, so that when there is nothing delivered by the radio set to that coil, there is no sound; but let the signal come in and go into that coil, then its energy can act on it and make it move; so that if hum goes in that coil and hum goes in this coil, and they are aiding each other, it will make this move and give you a hum in the air; but if the two hums in these coils oppose each other, then one is working one way and one the other, and they both oppose each other, and it does not move.

The Court: Now, then, with that introduction, explain what is the novelty of your idea over what was known before.

The Witness: Well, the novelty is that all sets had hum that come out, and were delivered to this field winding and delivered to this moving coil. There was bound to be hum in both of these coils, because it would be very expensive and almost impossible to make a set that would not give some of that electricity that causes the hum in those coils, so that it was very objectionable to have that hum coming out and spoiling the music; and we found that by proper connections in phasing and relative amplitude to those two hums, we could neutralize them so that the music that would come out would not be neutralized, but the hum would be.

The Court: Well, now, tell me how you did it again? You talked about the coils.

The Witness: Well, we did it by this reversing of either of those two little leads going in, or these two little leads that went to the moving coil; and as shown in our patent we inserted a condenser in series there. The condenser was something that changed the relative amounts of the hum in these two.

The Court: Where is that?

The Witness: That is not shown here. It is shown in the patent. So that if there was too much hum in one to balance out the other, we cut it down, and show that by several means, as the claim shows. We do not specify any particular means, but by these means, one of which is these that I have just pointed out, we were able to balance it out.

The Court: Are they all in there?

The Witness: Yes, this right here shows how the set is manufactured, so they have got to be connected right. You will notice this lead here—I will point that out—it does not reach over to here. They apparently make it short, so that the man that assembles it can not make a mistake and put it together wrong. It is these two leads here. That one won't reach over there.

The Court: When you say leads, you mean what?

The Witness: Wires.

The Court: Is the current simply coming out of the amplifier?

The Witness: That is the current that comes out to energize this field winding, and that is what we reverse to make the hum neutralized, and if that is not connected right, and there is no right amount of hum in both of them, the hum will be present; and in this set it is quite evident that they manufactured it so that the assembler can not put it together so that it would produce hum.

The Court: Well, I do not see that. Where does that lead start and end? Is it on these wires here?

The Witness: Yes, one of these wires here. It happens to be the one that is colored yellow, the yellow lead.

The Court: Where does it ultimately go?

The Witness: It ultimately goes back on this diagram.

The Court: Well, where does that come in here? That is what I want to see.

The Witness: We brought it down to this switch, so that we could reverse it to show the effect. Mr. Lowell will demonstrate that to you. It goes down to this switch and this is the reverse switch, so we could put the yellow lead where the other color was, and the other color where the yellow was, so we could reverse it, to show how, when we changed from what they had, there is hum.

Q. (By Mr. Brady) Referring to Exhibit 92, will you kindly explain further? A. That clarifies it, I think for you. This is the lead that I referred to. That is cut so short that it can not be put over there, because if it were put over there when they assembled it in the factory, it would produce hum; so they purposely made it short, so they could not do that. I think that is the fact. Now, this is the reversing switch that enables you here on this model to put that lead over there, and so that when you do it, you do get hum. That is nothing but a switch that takes this wire here and connects it over here, and takes that wire there and connects it over there. It merely reverses those connections.

Q. Please show us where that is on the board. A. Right here (indicating).

The Court: Well, now, why is that hum produced when you reverse it? A. Because the two hums, one in this little moving coil and one in this fixed coil aid each other, and cause this diaphragm to move badly and produce sound in the air, whereas when you throw this over the other way you reverse the connection and the hum in this coil opposes the hum in that, and therefore the two are acting in opposition, and this can not be transferred to the diaphragm, so that there is no sound in the air.

Q. Will you show how that hum is produced? A. I can demonstrate it here, if you turn it on.

(Set turned on.)

Q. Now, is the set operating normally? A. The set is operating normally now.

Q. How do you know that? A. Well, I tune in a signal here to let you hear it, as soon as it warms up.

(Set operating.)

The Witness: There is a signal on the set. Nothing has been done to set to change its operation.

Q. You mean the set is in its original condition? A. In its original condition now. You will notice there is no hum, and I just tune my dial a little bit off so I do not hear the station. Now, I will reverse these two connections to this coil, and you will hear that low hum that comes out that is objectionable, particularly when you want to listen to it without a great deal of volume, as is often the case. And in the bigger type of speakers, which reproduces this hum more efficiently, it would be louder.

Mr. Darby: Will you tune in the station again now while the hum is on?

The Witness: Yes, sir.

(Operating set.)

Mr. Darby: Mr. Witness, will you say that that hum interferes with the proper reception of that signal?

The Witness: Why, I would say that it interfered with the receiving, as I would run my set at home.

(Set operated by Mr. Darby.)

The Witness: That is the way you would operate a set in the street. I do not run mine that loud.

(Set operated by witness.)

The Witness: That is the way I would run it.

(Set operated by Mr. Darby.)

Mr. Darby: Now, will you please lower the volume control as you would run it in operation with that signal tuned out.

(Set operated by witness.)

Mr. Darby: That is the other one, isn't it?

The Witness: I still hear the hum just as bad if we change it.

Mr. Darby: Will you say that that hum interferes with the enjoyable reception of that signal?

The Witness: Yes.

Mr. Darby: You would?

The Witness: Yes, I would say that that hum was objectionable, and I would rather have a set that did not have it.

Mr. Darby: All right.

The Court: Well, do I understand this to be the sum and substance of your statement, that there is no novelty in setting these wires in this particular way, but the novelty lies in doing it in conjunction with the loud speaker.

The Witness: In conjunction with the loud speaker.

The Court: Wasn't all this known to the art before,—setting the two——

The Witness: But what was invention——

The Court: ——the fields against each other.

The Witness: Not from alternating current. The art had never operated this field coil before from alternating current supply. We were the first to get the power to supply this from—Those sets operated from batteries, and the energy from the batteries went down very rapidly in the old type battery set, and the main energy of the receiving set goes into this coil here, and it was that coil that we supplied with the alternating current, of course after it had been rectified, and it eliminated a very big drain on the batteries; so that there was no one before us, so far as we know, that ever had energized this coil from alternating current source and had the problem to confront them.

The Court: Well, I think I understand that a good deal better than I did.

(Witness then returned to the stand.)

Mr. Brady: The diagram referred to by the witness in the course of the examination and demonstration is offered in evidence as Plaintiffs' Exhibit No. 97.

(Diagram referred to marked "Plaintiffs' Exhibit No. 97.")

The Witness: As to what efforts we made, or what correspondence we had with respect to interesting others in our invention, I will say that we corresponded with the Magnavox Company in California, the only people at that time that made the type of loud speaker that had a field coil. Of course, they excited theirs from direct current; and we naturally thought they would be interested, being able to sell a device that did away with batteries to energize this coil, and operate it from the alternating current; and we wrote them regarding our invention.

I can produce that correspondence. I have it here. It is a letter dated June 10, 1922, to the Magnavox Company of Oakland, California, and also their reply. The date of the reply is June 19, 1922. There is another letter, in which we offered to build them up a model, if they would care to come and see it operate.

My attorney, John B. Brady wrote the two letters I have referred to as dated June 10, 1922 and June 28,

1922, addressed to the Magnavox Company. No, I wrote the letters myself, dated at my address, 2371 Champlain Street, Washington, D. C. The reply of June 19, 1922 is addressed to me. Mr. H. E. Metcalfe, of the Sales Department of the Magnavox Company, signed the reply. I signed the original letters, of which I have presented carbons.

Mr. Brady: The letters referred to by the witness are offered in evidence, and the Notary is asked to mark them Plaintiffs' Exhibit 98.

(Letters referred to marked "Plaintiffs' Exhibit No. 98.")

Mr. Darby: Objected to as irrelevant and immaterial.

The Court: I will admit it.

The Witness: At about the time of our joint invention, we had difficulty in obtaining parts, the component parts that were necessary to make the power amplifier and the loud speaker. At that time we had a great difficulty in getting the parts required for this new device, particularly a rectifier tube. There were no tubes then on the market for low power work. There were very high power tubes, but none for the use which we had for a rectifier tube, and also special transformers which we required, with a multiplicity of special winding and special voltages, were not available, and we were required to design and draw details for these and send them to the American Transformer Company, in order to get them made for our invention, to use in our invention. In our patent the transformer which we asked the American Transformer Company to build is No. 29 in Patent 1,606,212. Those parts are standard today. They were not standard at the time that Lowell and I were working. We wrote to the Westinghouse Company and the General Electric Company, with respect to obtaining a source of rectifier tubes but they were unable to furnish us with what we needed. I am handed two letters, one addressed to the General Electric Company, under date of July 28, 1923, and a reply by General Electric Company, dated August 3, 1923, and say that the one dated July 28th is one written by my attorney, Mr. Brady, asking them—asking the National Lamp Works

if they would quote on these special tubes for rectifying; and their answer of August 3rd to Mr. Brady stated that they had no tubes of the type we wanted, but they did say they had some of the higher power tubes, that would not serve our purpose.

Mr. Brady: The letters dated July 28, 1923 and the reply of August 3, 1923, by the General Electric Company, are offered in evidence as Plaintiffs' Exhibit No. 99.

(Letters referred to marked "Plaintiffs' Exhibit No. 99.")

Mr. Darby: Merely for the sake of the record I make the same objection.

The Court: Same ruling.

The Witness: I am handed two letters, one dated July 28, 1923, addressed to the Westinghouse Lamp Works, and a reply dated August 3, 1923, by Westinghouse Electric & Manufacturing Company. These are letters written by Mr. Brady relative to getting the special rectifier tubes and the reply by the Westinghouse Company, or the Westinghouse Lamp Works, stating that they could not furnish the type we desired.

Mr. Lowell and myself granted licenses to others to use the invention comprising the power amplifier and loud speaker of Patent 1,606,212. We granted a license to Grigsby Grunow Company and the Brandes Company.

Mr. Brady: The letters referred to by the witness, dated July 28, 1923, and the reply of the Westinghouse Electric and Manufacturing Company, dated August 3, 1923, are offered in evidence as Plaintiffs' Exhibit 100.

(Letters referred to marked "Plaintiffs' Exhibit No. 100".)

Mr. Darby: Same objection.

The Court: Same ruling.

The Witness: I am handed documents entitled license to Brandes Products Corporation, dated October 1, 1927. I find my signature thereon, and it is the license agreement which we drew up with the Brandes Products Corp-

oration. The license was executed. That is, the license was granted. The Brandes Products Corporation manufacture under that license. They made many thousands of sets under this license. I mean sets embodying our invention of Letters Patent 1,606,212. That is the power amplifier and loud speaker.

As to whether I have this confused with the invention of the two other patents, 1,455,141 and 1,635,117, I will say that we granted them licenses under those, too. There was a license under Letters Patent 1,606,212 to the Brandes Products Corporation.

Mr. Brady: License agreement referred to by the witness is offered in evidence as Plaintiffs' Exhibit 101.

(Paper referred to marked "Plaintiffs' Exhibit No. 101".)

The Witness: I am handed a license agreement executed November 18, 1927, with Grigsby Grunow & Hinds Company. This is an agreement which we made with Dubilier on Patent 1,606,212, with the Grigsby Grunow Company. That is the patent relating to the power amplifier and loud speaker. That license was executed. The Grigsby Grunow Company manufactured under that license. They made many thousands of sets under this license. I have a representative sample of such a set. We have one here. I will step down and identify the set.

(Witness leaves the stand and goes over to set.)

The Witness: This one here (indicating). It has the statement on it that it was built under license under Dunmore & Lowell patent. I will read the statement. It says, "License under Lowell and Dunmore patents, patents and application of Hazeltine Corporation, and P. R. Mallory & Company, Inc., and Magnavox Company." This is the leaflet of instructions of how to operate the set, which came with each set.

The Court: Now, I do not quite understand that. You say that is one of your sets.

The Witness: Made under our patents, along with other patents, of course.

The Court: I thought you said you did not have one.

The Witness: That was yesterday.

Mr. Brady: I do not think we said that. I think counsel on the other side made that statement. We have produced a set under the patent, and it is here.

The Court: I have had a demonstration for the last half hour on the other machine.

Mr. Brady: To show the infringement of the defendants' machine.

The Court: I asked to be shown the alleged patents, and I was told when I stood down there that you did not have one to show me, but you could show the same thing on the defendants' set. Isn't that a correct statement?

Mr. Darby: That is the statement, if your Honor please.

The Court: I do not want to go over it all again. You now say you have got what?

Mr. Brady: Yes?

The Court: The statement was made to me yesterday and today that you did not have one, and therefore you would like me to look at it on the defendants' device, isn't that true?

Mr. Brady: Not as I understand it, your Honor. My understanding is——

The Court: If I made a mistake, I want to be corrected. But isn't that what counsel told me?

Mr. Edwards: Not quite that, I think, your Honor. Mr. Darby——

The Court: Certainly I was told when I made the direct inquiry or statement that I did not want to see the alleged infringing device until I saw the plaintiffs' device, and I was told the plaintiffs did not have a set here that they could properly demonstrate it on.

Mr. Edwards: That was quite true yesterday, your Honor; and the reason the demonstration was made with respect to the defendant's was because that is opened up and we could reverse the coils. The statement today is that a number of those devices were made under the

patent in suit, and so one was brought over last night; and so far as physical properties are concerned, outwardly they appear alike, but in order to show whether or not the coils are reversed one must take the coils, cut the wires and make the reversal.

(Witness then returned to the stand.)

Mr. Darby: If the Court please, the plaintiff and the patent owner do not and never have manufactured and sold radio receiving sets. The set that they produce now has been manufactured by a licensee of theirs under this patent in suit, and some twenty-seven other patents and applications for patents, and your Honor is perfectly correct. The statement was made to you that they did not have one of their sets. They have not got any sets. Now, they come today with a licensee's set, manufactured under this patent, they say, plus the twenty-seven other patents and applications for patents under which they granted a license, as shown by the license agreement that they have put in evidence.

The Court: Well, if the loud speaker is in there under the license agreement, that would not make any difference, would it?

Mr. Darby: Well, it does not show that they employed the invention of this patent any more than the defendant does, for example.

Mr. Brady: We are prepared, your Honor, to make a demonstration of the apparatus we have here, that the invention is employed in the set.

Mr. Darby: The mere fact that you present it as a licensed set, an apparatus made under the Patent, I presume that you will contend and do contend that it contains the invention of the patent,

Mr. Brady: Of course, we propose to demonstrate that, Mr. Darby.

Mr. Darby: Fine. Whether you demonstrate it or not we will accept it.

Mr. Brady: We will demonstrate it.

Mr. Darby: Just a minute, all we want you to do is prove your case.

The Witness: I will step down and demonstrate the Grigsby Grunow set, manufactured under the license that I referred to, November 18, 1927. I will go through the same demonstration as I did with the other set. I will tune in a signal, and then turn it down low, and then I will reverse the windings, just as I did with the other set, and it will be noted that there will be hum present.

(Set put in operation.)

The Witness: Throw the switch one way and you have the hum, and the other way it is quiet. This is merely one representative set of various Grigsby Grunow sets. There has been no special effort to pick this set out of many others. It was picked at random from one of the men that happened to have one.

Mr. Brady: I offer license of November 18, 1927, to the Grigsby-Grunow-Hinds Company, as Plaintiffs' Exhibit No. 102.

(Paper referred to marked "Plaintiffs' Exhibit No. 102.").

Mr. Brady: The Grigsby-Grunow set referred to by the witness and demonstrated by him is offered in evidence as Plaintiffs' Exhibit No. 103.

(Set referred to marked "Plaintiffs' Exhibit No. 103.")

Mr. Brady: Witness excused.

Mr. Darby: No cross-examination.

The Witness: I just want to make one statement, that I do not recall hearing your Honor ask if we had one present today. I know yesterday you asked if we had one present.

The Court: Well, I do not know whether I asked again today, because I was told yesterday that you did not have one.

(Examination of witness concluded.)

Mr. Edwards: I offer in evidence the bread board model that was refetred to yesterday by Dr. Lee, and upon which he made a demonstration. I will ask to have this model marked "Plaintiffs' Exhibit 104."

(Model referred to marked "Plaintiffs' Exhibit 104.")

Mr. Edwards: I will also offer in evidence a letter written by plaintiffs' counsel on August 5, 1933, to the defendant Baltimore Gas Light Company; and I understand that it is admitted that such letter was received at or about the date of the letter. The letter is the usual formal notice of infringement. That would be 105.

(Letter referred to marked "Plaintiff's Exhibit 105.")

Thereupon PERCIVAL D. LOWELL, a witness of lawful age, produced on behalf of the plaintiffs, having been first duly sworn, testified as follows:

Direct Examination.

By Mr. Brady:

The Witness: I am the joint-inventor with Francis W. Dunmore, named in Letters Patent 1,606,212. This invention refers to a power amplifier and loud speaker. I have records to establish the time Dunmore and myself made this invention.

Mr. Darby: I think we conceded that. That has been conceded, Mr. Brady.

The Witness: I prepared an official report for the Department of Commerce, relating to the invention I made with Mr. Dunmore on the power amplifier and loud speaker. There was a circular, an official circular which I wrote, covering this subject. I can produce a copy of that circular. The title of the circular is "Scientific Paper of the Bureau of Standards, No. 450." It is dated October 2, 1922. The invention of Mr. Dunmore and myself is disclosed in that circular in the diagram on page 350.

In Plaintiffs' Exhibit No. 91, I can show you the condition of the hum energy in the output system of that set by operating the receiver.

Q. Will you please do so?

The Court: Now, is that necessary?

Mr. Darby: He has done that twice.

The Court: That is just going over what has been done before.

Mr. Brady: No, your Honor, this is quite a different test. He made a test with regard to the voice coil and the field coil and the electric dynamic speaker. This witness proposes to show the condition of the hum energy in the output system of the set, the main filter.

The Court: I do not understand you.

Mr. Brady: The prior witnesses have told us that existing in this main field coil there is a ripple, an alternating current component. That has been shown by reversing the field coil. Now, how does the alternating current get into the coils to be neutralized? There must be alternating current coming from that set; so I am asking this witness to show us——

The Court: Well, we eliminated that in the discussion this morning, didn't we?

Mr. Brady: Why, I do not believe so, your Honor, because there must be some hum energy there.

The Court: Well, that is assumed, and that is why I asked those various questions, and kept coming back all the time to that premise; and I understand it has been accepted by all parties concerned,—and it does not make any difference how you produce it,—that the alleged novelty relates to a situation where you have already produced it, so I am not concerned with going into that at all.

Mr. Brady: Then, may I consider that we are agreed that if we tested the output of this receiver we would find a large volume of hum energy.

The Court: Well, I understand that that is the only purpose of the invention, to apply the loud speaker to a set where you do have the hum. That is what Mr. Dunmore has just been telling me for the last hour, unless I am wrong.

Mr. Brady: The test that Mr. Lowell is about to make will show, without any doubt, that that is the case. Then, it is understood that the hum, when it gets into the loud speaker must come from the receiving set, and if we

made this test we would hear a loud hum from the receiving set.

Mr. Edwards: You mean the defendant's set?

Mr. Brady: In the defendant's circuit.

Mr. Darby: Yes, as set up on your table there.

Mr. Brady: Yes.

Mr. Darby: Yes, as set upon your table.

Mr. Brady: Then, do the counsel concede that point?

Mr. Darby: As you set it up on that table, there is no question that you get hum out of the last, output of the apparatus part as distinguished from the receiver part.

The Witness: This Stewart-Warner model No. 109 is in no different condition now than it was when I originally received it, except the addition of the switches and the associated wires which I put on. So far as I know, there was no effort made to select some specific Stewart-Warner Model No. 109 set. It is just a general run-of-the-mine set as far as I know. I did not do anything to the set which would inject hum into it. As to whether it is set up any differently here than it would be in the ordinary way. I will say that it is different only in that in the ordinary way it is assembled in the cabinet. Here we have assembled it on a board. This device here (indicating) is the cabinet in which the receiver was assembled when I received it.

Mr. Brady: Referring to Exhibit 82.

The Witness: I took the chassis out of the cabinet. After I took it out I mounted it on the board, as shown there, and brought out the leads in various parts. I did not do anything to disturb the circuit of that set which would introduce hum into the circuit.

As to whether I can give some simple analogy to the problem that we have been trying to solve in our minds to explain this invention, I would like to try to show by a very simple mechanical analogy on the blackboard, if your Honor is not quite clear——

The Court: Turn the other side of the board around.

(Diagram drawn on blackboard by witness.)

Mr. Brady: If I may interrupt, I will offer in evidence as Plaintiffs' Exhibit 106 the Bureau of Standards Scientific Paper No. 450, referred to by the witness.

(Paper referred to marked "Plaintiffs' Exhibit No. 106.")

The Witness: This diagram represents a combination of moving pistons and springs. I will mark this one piston over here P-1 and this piston rod on the right I shall call P-2. These pistons are arranged so that they may be actuated either simultaneously or independently, to give the backward and forward motion as indicated by the arrow above the pistons. Connected with these pistons are two springs, which are joined together in the center. And at the center we have what we call an indicator. I will mark that "I". This indicator is attached only to the center of the spring, so that it is free to move backward and forward. In the condition where the two pistons P-1 and P-2 are at rest, the indicator then, of course, will rest on a point which we will call zero. Now, if we start the machinery which operates piston P-1 and moves it back and forth, the motion of the piston P-1 is transmitted through the spring, S-1, and causes the pointer, the indicator, I, to move from the zero position to a position to the right, to cause it to fall in a positive direction, and we will assume it moves over to the point which we will call ten units of motion. Now, if we stop the movement of piston P-1 and start piston P-2 reciprocating, we get the same effect through the spring S-2. In this case the indicator moves from the zero point in a negative direction in equal amount, which we call ten units of motion. Now, we operate both pistons simultaneously, P-1 and P-2, but in such manner that they are synchronized, they are in phase, both moving in the same direction at the same time. With that condition the indicator will move between the two extreme positions, so that we get a total of twenty units of motion. Now, again, if we move both pistons simultaneously, but in opposite directions, the force exerted through the two springs is equal and opposite, and we get no motion of the pointer; it remains at zero. Now, that represents exactly what happens in this patent. The motion of the piston P-1 can be compared to the hum current which is

generated in the field winding of the speaker; and we can call P-1 speaker hum. And the motion of piston P-2 is analogous to the motion of the hum current received from the receiver itself, the amplifier; so we can call that receiver hum. Now, the indicator in this case being acted upon by the two forces is analogous to the moving coil of the speaker. We will call that moving coil. Now, I think it is very simple to see that we have two hum currents, one generated in the speaker itself and the other from the receiver, both acting simultaneously upon the moving coil, and if properly phased in relation to those two hum currents, they will either add up and produce twenty units of hum, or connected properly, as disclosed in our patent, they will cancel out and produce zero units of hum.

The Court: Is that akin to the same principle in a telephone, the ear-piece?

The Witness: Somewhat, but the telephone receiver is an entirely different electrical construction than a loud speaker.

The Court: Why doesn't it have the same problems? You have the current and you have the voice.

The Witness: In a telephone receiver, it uses a permanent magnet instead of an electro magnet. That is the magnet. But instead of the magnet having permanent wiring on it, it is a horse-shoe magnet. That is, in a telephone receiver you do not need as much power, you do not need to reproduce the voice as loud as you do in the loud speaker.

By the Court:

Q. What I mean, is the principle the same, having one energy offset the other? A. No, sir, you can not do that with a telephone receiver because the telephone receiver operates without the use of any external power. That is, you can not introduce any hum in the telephone speaker. If you take a telephone receiver and connect it on the hum of the defendant's output, you would get a receiver hum only. You can not introduce any hum to the telephone receiver.

The Court: Well, I will take your word for it, but I know that if you put the ear-piece to your ear you have

the sound of the voice coming in and also you have the hum magnified so you can hear it. Now, what I was asking you was, isn't it the same problem they had to deal with in the early telephone invention days to eliminate the hum?

A. Why, I am not prepared to enlighten you very much on the early telephone practice, sir. I do not think they have hum problems in the telephone service. I may be wrong.

The Court: Well, I understand your idea of it. Have you finished with Mr. Lowell?

By Mr. Brady:

Q. Does a telephone normally use direct or alternating current? A. Direct current. I mean it is a direct current device instead of an alternating current device.

(No cross-exa... n.)

(Examination of the witness concluded.)

The Court: Does that conclude the plaintiffs' case?

Mr. Edwards: Not quite, your Honor. It is stipulated that a reproduction of the drawing made by the witness Lowell may be made and is hereby made and offered in evidence as Plaintiffs' Exhibit 107.

I hereby offer in evidence as Plaintiffs' Exhibit 108, "Instructions for care and operation of the Majestic screen grid radio receivers August, 1931", referred to by the witness Dunmore.

Before closing our case, your Honor, in order that it be clear on the record, I desire to renew our offer to call witnesses and introduce the proof of the facts as set forth in the memoranda already filed with the Court and the exhibits accompanying that memoranda, as the understanding the other day was that the witnesses would not be allowed to testify. I desire at this time to make my formal offer.

The Court: That has relation to the other patents?

Mr. Edwards: Precisely.

The Court: Well, I have already ruled on that. Why do you bring it up again? I do not quite understand it.

Mr. Edwards: Because, to be frank, your Honor, I am not quite clear as to just where we stand on the record, and I would like the record to show that at every opportunity we have sought to introduce this evidence, and I take it from what your Honor says now, that it is excluded, and, if so, I would like to have my exception noted.

The Court: Very well.

Mr. Edwards: And may I ask to have that document and the exhibits marked under the Equity Rule No. 46 to show my offer?

The Court: You have made that offer and I told you you could have an exception and I would pass later on whether that ought to be made a part of the record.

Mr. Edwards: I understood yesterday there was some question made as to whether that was during the trial or before the trial, and not being certain myself as to what view ultimately would be taken of that situation, I make the offer now.

The Court: All right, sir.

Mr. Edwards: And in that connection I again ask that the documents be marked under Rule 46.

(Proffer marked "Plaintiffs' Exhibit—Evidence Offered under Rule 46.")

The plaintiffs rest.

(Evidence on behalf of the plaintiffs concluded.)

DEFENDANTS' CASE.

Mr. Darby: May it please the Court, to enable an understanding of the defendants' position in this case, in view of the fact that our evidence is almost entirely stipulated in, from the previous trial, there is just one little element of scientific fact that I would like to explain to the Court to enable a clear understanding of the particular inventions here involved.

The Court: Might I interrupt you right there? It is stipulated—what is the nature and extent of it?

Mr. Darby: It is the evidence that was given in the prior trial pertaining exclusively to this patent in suit.

The Court: Didn't it bear upon anticipation?

Mr. Darby: It bore upon anticipation, want of invention, and non-infringement. The receiver before the Court, the loud speaker before the Court in the previous trial before Judge Morris, which was held not to infringe, is the same as the receiver of the defendants in this case with one very slight difference, and I will explain to your Honor in just a minute what that difference is. I will tell it to you very briefly now and then come back to it. In the defendants' speaker the Radio Corporation's loud speaker known as No. 104, they employed the same instrumentalities that the present defendant does with the exception that in addition the Radio Corporation had what is referred to copper discs. These little copper discs were put into the loud speaker arrangement to act as what was there termed a shield. It was because of the use of these little copper discs that in that case the plaintiff contended infringement occurred. In this case we do not use the copper discs, so that our position is that the one thing that they relied upon to establish infringement in the Radio Corporation case we do not use, which brings the question of infringement even further away from what it was in the case before Judge Morris.

The Court: Does the Court stress that point?

Mr. Darby: I think so. I was going to, in just a minute, call the Court's attention to a short passage from the opinion of Judge Morris and explain it as I went along.

The Court: All right.

Mr. Darby: I first wanted to get in layman's language, and make homely analogies, if possible, to explain just what the invention here is concerned about. Every sound that we utter or hear is a matter of vibration. Your Honor will undoubtedly recall in your early school days you hit a tuning fork and you would get a note. Now, that note that you heard was nothing more or less than the vibrations that the tuning fork had. When I talk my larynx causes vibrations in the air and those vibrations go through the air and impinge upon your Honor's ear drum and the same vibration occurs in your

Honor's ear drum that occurred in my larynx and that is why you hear it. Anything that vibrates a certain number of times per second within the audible limit, as it is called, you will hear. The audible limits are generally accepted as lying between 16 vibrations a second, which is the lowest note that human ear can hear, and approximately 15,000 vibrations per second, which is the highest note the human ear can hear.

Now, when you talk into a telephone transmitter your larynx causes air vibrations which impinge upon the little disc that you see in the telephone transmitter and causes that disc to vibrate in accordance with the air vibrations that your larynx has caused. The vibration of that little disc alters an electric current and makes that electric current flutter, if you please, in accordance with the vibrations that have originated in your larynx. Now, that electric current flows over the wires and with the flutter in it until it comes to the receiver of the one to whom you are talking in that receiver—if you have ever examined your telephone receiver you will find that it likewise has a little metal disc—that metal disc is actuated upon by a magnet and this electric current that is fluttering electric current flows through that magnet and that magnet attracts that disc more or less depending upon the flutter of the electric current, so that that disc in turn vibrates just exactly the same way that your transmitter disc vibrated, and that vibrates the air and consequently you get the sound that you hear.

A radio receiving set operates exactly the same way. At the broadcasting station they are transmitting wireless waves. The only difference is instead of running over a wire they go through the ether, the air, and these wireless waves are caused to flutter by the music, speech or signal, whatever it may be, that is to be sent by wireless. These currents flutter which is a modulation, as we say, of the current that is constantly being sent forth. These waves flowing through the air, going through the air, impinge upon an aerial, the antennae, and they follow that antennae right down to the ground, but in going down through that antennae they encounter a coil, nothing but a wire coiled around something, or around air, for that matter, which is part of a transformer, and when current flows through that coil it induces, we say, but you can visualize it as jumping from one coil to another,

current in a second coil, which is connected to your radio receiver. It is in as a part of your radio receiver. So depending upon how strong the signal was, how strong this wave was when it left the transmitting station, and likewise depending upon how far away your receiving set is and, perhaps, other conditions with which we are not concerned, that current, this fluttering current, corresponding to the original sound wave, is received by your radio receiver and led into the receiving set itself, but it is awfully weak—likewise it is high frequency current—so it is acted upon by the apparatus of the receiver, the vacuum tubes and other instrumentalities in there, to make it stronger and to put it in a condition to ultimately come to the loud speaker in the form of a fluttering current which is exactly similar in character to the fluttering current that is received at the disc or the magnet, rather, of your telephone receiver that you hold to your ear.

Now, that is a very brief and simple explanation of radio transmission. This patent is concerned only with the fluttering current that comes out of the apparatus to be led to the disc or loud speaker. The loud speaker of a radio instead of being the disc in the telephone receiver is a piece of parchment, stiff board, cardboard, stiff paper or something of that nature, usualy in the shape of a cone, because it has been found that a cone is best adaptable to reproduce the vibrations in the air in the form of sound.

Now, the current, this fluttering current that ultimately reaches this loud speaker is still very weak. It is desirable, it is advantageous to make it stronger. Therefore, instead of using a permanent magnet for controlling the movement of the cone in reproducing the sound wave vibrations, they use what they call a dynamic speaker, with which this case is involved, which is nothing more nor less than a magnet which is not permanent, but is made into a magnet only when electrical current is flowing through it. That is called an electrical magnet. Therefore, to get this amplifying effect—it is nothing but a booster,—and they use an electro magnet and energize it directly from your electric lighting circuit. That is what they have referred to in this case thus far as the field coil, the fluttering current finally reaches that coil,

moving the cone back and forth, that is called the speech coil.

Now, if your Honor will refer to the patent, figure 1 of patent 1,606,212, your Honor will see the speech coil 9. That is the coil to which the fluttering current, which has been made to flutter by and in accordance with the original speech or signal, that coil is connected directly to the cone of the loud speaker.

The Court: Now, wait; I do not see that here.

Mr. Darby: The coil 9, the loud speaker—the cone of the loud speaker is not shown in the drawing.

The Court: It does not appear to be connected with any.

Mr. Darby: I know it. That is true, your Honor. But that coil 9 is intended to be, and I believe it is a reasonable conclusion from the patent itself—it is described as being connected directly to the reproducing device, the cone; there is no question about that; there is no dispute about that. So that fluttering current which contains the signal ultimately reaches coil No. 9. Now, to secure magnified effect, amplified effect, a field, 10, is employed and energized from a source of alternating current. The current that reaches the field coil, 10, is alternating current. Alternating current reaching the coil 10 would be bad. Therefore, they pass it through a rectifier, which takes this alternating current out, which consists one moment of positive electricity, the next moment of negative electricity, the next moment of positive electricity, and so on. This rectifier cuts that in and off, and utilizes all of the positive components, but not the negative, or vice versa. It could use all of the negative components and not the positive. If you will visualize the current, the alternating current is being in this form (indicating on drawing on the blackboard). Here is the zero line. The alternating current swings like a pendulum. Above the zero line it is positive, and then it comes down to zero, and negative, and goes back to zero, and goes into positive, and so on. Now, when you rectify that current, you only use one component, either the positive or the negative; and let us say we will only use the positive component; we will just erase the negative component. And that is what you have got. And your

Honor will see that instead of having a continuous current you have intermittent current. It is what they call pulsating current; just like turning on and off the tap water faucet; you get a glob of water, and you turn it off and you get nothing, and you turn it on again and you get some more water. And that is just what a half wave rectifier does. It is direct current, but it is pulsating intermittently; at first a glob of electricity, nothing, a glob of electricity, nothing, and so on.

Now, you must use direct current for energizing the field coil 10. Therefore, the patentee rectifies half of the alternating current that he gets from his electric light mains and gets his intermittent pulsating current, which is bad, because, if you get that intermittent pulsating current, you are going to get your 60-cycle hum. Now, your Honor will notice that he does nothing. Nothing is shown, and nothing is described in his patent. He puts nothing between the rectifier and the magnet 10. There is, of course, the fluttering current in the circuit of coil 9. Therefore—and this constitutes the sole invention of the patent, if you please—therefore, he says I am going to recognize that there is a 60-cycle hum, there is alternating current or pulsating current in the circuit of coil 10, which flows through that coil, and there is likewise a 60-cycle hum in the circuit of coil 9, which flows from that coil; and he says, "I am going to suppress, I am going to correct my system so as to eliminate that hum." In other words, it is a method of cure. He says, I am going to allow it to be there, and then do something to counteract it. So, if we have two coils, which I will show that way, (drawing diagram on blackboard), connected with each other, and I pass current this way, in both coils, their effects will be additive, they are added together; but if I—and this is another analogy such as was used by Lowell—if, however, I cause the current in the upper coil to move this way, and the current in the lower coil to move in the opposite way, they are going to buck each other and neutralize each other. Now, therefore, the invention of the patent, and the sole invention of the patent is in connecting the terminals of either one of those coils 9 or 10, in such a way that they oppose each other; the currents flowing through them are in opposite directions with respect to each other, so that they neutralize the hum effect; in other words, they allow the hum effect to be present, and after once present they

provide that particular circuit connection to buck it out, to oppose each other, to neutralize that hum, from which your Honor will see immediately that if anybody took exactly this arrangement here and connected those coils, so that they did not oppose each other, there would be no infringement. If they connected the coils so that they did oppose each other, according to the plaintiff, there would be an infringement. And if your Honor will refer to any one of the claims, let us take claim——

The Court: The Court in the other case took two.

Mr. Darby: All right, sir, we will take two. The only element that we need to consider is the last one. It calls for a loud speaker reproducer connected in the output circuit and field winding, and circuits for supplying rectifying current to said output and field winding, "Said windings being connected in such relation that disturbing current effects in said loud speaker reproducer are substantially eliminated."

Now, the only such connection, being connected in such relation—the only relation that is described anywhere in the patent for those two coils 9 and 10, which would accomplish that result is by having them opposed to each other; and that, of course, is entirely consistent with the evidence that has been given.

Claim 3, for example, is even more specific. The last element is, "Said windings being so connected with said means as to substantially oppose the effect of disturbing currents in said loud speaker reproducer."

Now, with that in mind, let me tell your Honor what the defendant's receiver is. The defendant's receiver eliminates hum in an entirely different way. Instead of using the method of cure which necessarily implies allowing the hum to be present, and then wiping it out, it is using what is—and your Honor will undoubtedly recognize the phrase, because it is used in the opinions—it uses the method of prevention, which does not permit the hum to get into the circuit leading to the field coil. And I will tell you how they eliminate it; it is exactly as the Radio Corporation loud speaker does. The defendant uses what is called a filter. It puts in the circuit—well, first, let me say this: Instead of using a half wave rectifier, such as the plaintiffs' patent shows, it uses a full

wave rectifier. In other words, it uses not only the positive component of the alternating current, but it also uses the negative component of the alternating current, so that the current that it gets fills in this gap between the other tube. That is the first vital difference. The second vital difference is this: We use a filter. After we get this rectified current, both the positive and negative components, we pass it through a filter which smooths out, cleans out all hum. I can compare that filter, for example, to give a homely analog, to purified water coming out of the top of the faucet. You put a wad of cotton above the outlet of a water faucet, so that all the water comes through there, and the water that you finally get in your drinking glass is pure, because the cotton has taken out all of the impurities. That is the method of prevention. The method of cure would be to allow the poisoned water to get into the drinking glass, and then pour some chemical in that drinking glass, which would kill the poison or counteract the poison. That is the method of the patent, the method of cure. A filter, an electrical filter, consists of condensers, resistances, inductances, such, for example, as the witness Dr. Lee referred to in connection with the Hull Patent, a patent owned by the General Electric Company, under which the manufacture of defendant's radio receiver is licensed. That takes this alternating current, eliminates the hum, so that when it passes finally to the loud speaker it does not make any difference whatever whether the phase of one coil is the same as or opposed to the phase of the current in the other coil.

The Court: Well, now, isn't that contrary to what the inventor said?

Mr. Darby: It is flatly contrary to what the inventor said.

The Court: I mean you are now bringing in the set which they said had nothing to do with their invention.

Mr. Darby: Oh, no, sir, oh, no, sir. I am confining myself right straight through to this same two coils, 9 and 10 of the patent in suit, referring to the corresponding coils which we use in our loud speaker, and which they do not claim, if the Court please, that there is anything in this set-up novel except to so connect those two coils, and each of which are old in the art and old in that

connection—except to connect them when current flows through both of them, which will flow in opposite direction instead of the same direction, thereby eliminating the hum.

Now, we use exactly the same arrangement, but we interpose between this rectifier, 14—we use a full wave rectifier—we interpose between that rectifier 14 and the field coil 10 a filter system, which your Honor will see—may I pass this up to your Honor—I call your attention to the device marked—this is Plaintiffs' Exhibit 95, or a copy of it—the devices marked 8-A (handing to court). That is a diagrammatical illustration of what is known in the art as a filter, for the purpose of smoothing out any undulations, any fluttering that may exist in the circuit. That is what we use. That is what the Radio Corporation of America used. And that is what the Court held completely avoided this patent as operating on an entirely different principle. In other words, we kill the hum at the source. They permit the hum to be there.

The Court: Well, how could you say you kill it at the source.

Mr. Darby: We kill it at the source in the rectifier, if your Honor please. We use alternating current; everybody does. But when we pass that current directly from the lighting mains to the rectifier, just like everybody does—from the rectifier to the loud speaker is direct current, but that direct current has been so completely cleaned up by this filter, the impurities have been wiped out, that the minute the current is going from the apparatus, as your Honor calls it, to the loud speaker, at least to the field coil of the loud speaker, it is pure direct current; and we can demonstrate it to your Honor and will demonstrate it very, very simply.

The Court: Well, let me see if I understand you. You are not differing with the plaintiffs on the point that if they have any patentable novelty it lies solely in their loud speaker.

Mr. Darby: No, sir, that is——

The Court: You contend that was novelty, or, rather, that you accomplish what they accomplish in another part of the apparatus.

Mr. Darby: We accomplish——

The Court: And that, therefore, it does not infringe, if you do it in the rectifier and they do it in the loud speaker. Do I understand you right?

Mr. Darby: No, sir, that does not exactly correctly state it. I can restate it this way. We accomplish the same result that they do in an entirely different way, and not in the specific way that their patent is expressly limited to, by its very terms, and by the prior art.

The Court: Well, not only in the way, but in the place.

Mr. Darby: We do it in a different place, absolutely, that is correct.

The Court: That helps me to understand it.

Mr. Darby: We do it in an entirely different place, we do it at the rectifier, and they do it up at the loud speaker itself, that is correct, your Honor.

The Court: Well, that is just what I said, isn't it?

Mr. Darby: I misunderstood you. I agreed with you fully.

Now, with that understanding, might I call the Court's attention, and perhaps explain very briefly a short excerpt of Judge Morris' opinion, and before I do that, let me say this, from the file history of the patent, this patent application was applied for, and a number of claims presented, and all of the claims were rejected. Then, in March, 1926, four years after the patent application had been filed, they inserted for the first time, if you please, the very thing that they now claim is the invention; and Judge Morris says in connection with that, if your Honor can follow me——

The Court: Yes, I can follow you. I think I have it. It is the paragraph beginning with "Regardless of the fact".

The Court: Paragraph "Regardless"——

Mr. Darby: Beginning with what, your Honor?

The Court: "Regardless of the fact"?

Mr. Darby: No, sir. I was starting—I am reading from the opinion as it appears in the Appeals record and the part that I have is, "Defendant contends"——

The Court: The opinion in the Appeals record?

Mr. Darby: Yes. I have not the Federal Reporter here.

The Court: I thought you meant the Court of Appeals. I did not understand that because the case did not go up.

Mr. Darby: Judge Morris rendered just one opinion on all three.

The Court: Go ahead.

Mr. Darby: The paragraph begins, "Defendant contends that the amendment was and is"——

The Court: I have it.

Mr. Darby: It is the sentence immediately preceding that, your Honor: "In addition the patentees pointed out by amendment of March 27, 1926, that pulsations in the field winding and in the armature circuit are opposite in phase and that there is a consequent tendency for the disturbing pulsations to offset and neutralize each other."

Now, that is what they here advance as the invention as well.

The Court goes on: "The defendant contends that the amendment was and is invalid in that it contains new matter and was made about six months after defendant's loud speaker went on the market. It further contends that the claims are based on the amendment and that they, too, must fall not only for want of proper foundation in the specifications but also because of anticipation by Pridham and Jensen's patent"—to which I will refer a little later—"and because, if they are not limited by phase opposition, they are merely for an amplifier, old per se, aggregated with the old Magnavox loud speaker. Defendant likewise urges that its loud speaker is not within the scope of the claims when properly construed. Plaintiff takes the position that the amendment did not introduce new matter in any invalidating sense in that,

as they assert, the amendment was in effect but an explanation of the theory upon which the device operated or functioned in part. They further contend that the claims in issue even if construed to include phase opposition are not anticipated by the Pridham and Jensen patent; that since other claims not in issue are specific to phase opposition the claims in issue should not be so construed to be limited by phase opposition, but that howsoever construed, defendant's loud speaker comes within them."

Now, that, I think, summarizes the identical issues here before the Court, and if you will skip—I do not want to waste too much time reading it—the Court suggests claim 2, cities the fundamental proposition of law that the claims can not be given a construction broad enough to confer upon the patentees a right to the exclusive use of alternating current for producing their result, citing O'Reilly vs. Morse, 15 How 62.

Then says: "Separately considered, both the amplifier and the loud speaker were old. Skin effect and impedance, which includes reactance and resistance, were known inevitable consequences of the energization of field coils of the Magnavox type by pulsating current."

Translating that, that means jus this, that any inductance acts to smooth out a current and eliminates the fluttering or pulsations. That is referred to as skin effect. Impedance is an electric constant. It might include a reactance or resistance or something of that nature. And then the Court goes on: "In view of the lack of novelty in the amplifier and in the loud speaker, separately considered, and of its failure to find any cooperative effect set out in the specifications, the Patent Office rejected all claims. Thereafter the patentees amended by adding the matter now appearing in lines 65 to 79 on page 2 and in lines 24 to 33 of page 3 of the patent." And those lines, if the Court pleases, are the lines in the patent specifications which describe the thing that the inventor now tells the Court is the invention of the patent, namely, putting the two coils so that current will flow through in opposite direction so that they will buck each other and neutralize each other. That is what was injected into the application and into all of the claims four years after the application was filed, and after the Radio Corporation's Loud speaker No. 104 was on the market.

Then the Court goes on: "All claims were likewise amended. As a consequence of these facts and actions, all claims must be held to include and be limited by the interaction or cooperation disclosed in the amendment."

In other words, the Court there holds what plaintiff apparently is quite willing to accept now, that the invention of the patent is in opposing the phase, opposed phase, in these two coils 9 and 10.

Then the Court goes on: "If these claims were anticipated by the Pridham and Jensen patent, or in the amendments, the keystone of the supporting arch for the claims, contained new matter in an invalidating sense, the claims must, of course, fall, but as I can find no infringement by defendant's loud speaker of the claims when limited by phase opposition, it is unnecessary to pass upon the validity of the claims."

Let me hesitate there to briefly comment on this Pridham and Jensen patent.

The Court: Why not take up one thing at a time?

Mr. Darby: All right, sir.

The Court: I am certainly not disposed to do more than the Court in Delaware did. If I understand your contention it is that you have a different device, just as they had in Delaware, therefore, that your contention is non-infringement. If you can satisfy me on that, that is as far as I am going. That is as far as the Court went in Delaware.

Mr. Darby: I am going to satisfy your Honor on that, I believe.

The Court: That is as far as I ever go in these patent cases unless there is something unusual involved. Why not stick to the question of infringement first and get that out of the way?

Mr. Darby: I will. Then I will continue on this. I have just got a little more to read from Judge Morris' opinion: "Plaintiffs expressly concede that there is no Cooperation between defendants' amplifier and loud speaker to neutralize or eliminate directly by phase opposition the hum producing fluctuations."

The Court: Where is that?

Mr. Darby: Right where I left off reading before. It begins: "Plaintiffs expressly concede that there is no cooperation between defendants' amplifier"—does your Honor find it?

The Court: Yes.

Mr. Darby: —"and loud speaker to neutralize or eliminate directly by phase opposition the hum producing fluctuations." Now, plaintiffs contend exactly to the contrary in this case. They say that there is in the defendants' loud speaker. And the Court goes on: "They assert, however, that defendants through equivalents employs the means of the claims to produce the result of the patent. But defendants' device is designed"—and this is important—"But the defendants' device is designed to eliminate from the amplifier circuit and from the field coil circuit any and all hum producing fluctuations there present and to leave no residual fluctuations to be neutralized by cooperation between the amplifier and loud speaker." In other words, there as here we contend that we use a filter to eliminate all hum and there is no neutralization in these two coils, 9 and 10, or at least our coils which correspond to coils 9 and 10 of the patent, just exactly as Judge Morris stated.

And then the Court goes on: "The means used by defendant to make its field coil current steady and pulsationless and to shield its armature coil from the effect of residual fluctuations or magnet leakage include, in addition to the impedance and skin effects of the coil itself, a full wave rectifier instead of a half way- rectifier of the patent." We use, if the Court please, the full wave rectifier instead of a half wave rectifier of the patent. Then it goes on: "A filter to smooth out the ripples in the rectified current, a pot magnet"——

The Court: What is that?

Mr. Darby: We use a filter to smooth out the ripples of the rectified current. "A pot magnet"—— We use a pot magnet. "The placing of the armature coil"——

The Court: What is a pot magnet?

Mr. Darby: A pot magnet consists—it looks just like a pot. That is where it gets its name. In cross-section it looks like this, your Honor.

(Illustrating on blackboard).

It is shaped like a pot and the magnet is located in here. Your Honor will recall in defendants' loud speaker that you inspected with Mr. Dunmore, I think it was—you asked him to take off the back part? That is the pot. We use a pot magnet and the Court points out, as the testimony in the case which will come in in a few minutes points out, that the use of the pot magnet is—"the placing of the armature coil in as non-inductive relation as possible to the field and copper rings to shield the armature coil from the effects of any surviving current pulsations." Now, we do not use that. Then the Court goes on: "Defendant's mode of operation is the direct antithesis of that of the device of the patent which intentionally employs neutralization by direct phase opposition."

That applies to us absolutely as well. Now, here is what they say about the rings: "Plaintiffs, however, insist that ripples of hum frequency in the current of the field winding cause magnetic fluctuations that produce eddy currents in the copper rings, that the same results flow from alternating current variations in the armature coil and that these currents are in opposed phase relation to the producing current and consequently bring about opposed phase relationship." In other words, while we are identical with the 104 loud speaker of the Radio Corporation in every respect save one. That one respect, the use of these copper rings was the very thing that the plaintiff in the prior case relied upon to establish that they did use phase relation. Therefore, when we eliminate the copper rings entirely, not only have we eliminated the one thing on which they hung their hat in the prior case, but we have taken their structure completely out of the patent.

Then the Court goes on: "But even if this theory be sound, and its soundness is questioned, the phase opposition of the patent is direct, not echoed." In other words, the Court said the phase opposition is right in these coils 9 and 10.

The Court: To boil down what you have said up to date, would you have me to believe, in spite of having stood down there for about an hour, or the better part of an hour, listening to the analysis of the inventor him-

self that he did have phase opposition and his device was exactly like the one set up there in so far as the loud speaker was concerned, that in spite of that you say what he tells me about his own patent is not true?

Mr. Darby: No, sir, I do not say that.

The Court: Let me see, now—I do not want to make a wrong statement, but doesn't it come down to that?

Mr. Darby: It comes down to this—I am sorry.

The Court: Let me make myself clearer. I went down to the table and he told me that he claimed nothing,—he claimed no novelty existed anywhere,—except in the loud speaker and unless I very completely misunderstood him he said that his whole point of the alleged novelty was in his phase opposition in the loud speaker.

Mr. Darby: That is correct.

The Court: And then Mr. Lowell, the other inventor, came here and drew that thing on the blackboard to show me the analogy between pistons and the electric current. Now, if they are right in saying that phase opposition means the loud speaker unit, which is what they claim is the novelty, do you say that it is not in there at all?

Mr. Darby: No, sir. You misunderstand me, your Honor. I agree with them one hundred per cent. That is what their invention, that is what their patent discloses, and that is the only invention there disclosed, and the only invention they claim is disclosed.

The Court: I have not quite finished. But, as I understand that, they take that device, which was yours, to illustrate it——

Mr. Darby: Yes, sir.

The Court: —to illustrate that the phase opposition is in the loud speaker. Now, you come along and tell me that the phase opposition is not in that device at all.

Mr. Darby: It is not in our device, if the Court please.

The Court: That is the one that he demonstrated from.

Mr. Darby: Yes; but he has taken our apparatus apart, disassembled it, has added a lot of equipment,

and I do not know what else has happened to that speaker. I will tell you what we did to prove to your Honor that our commercial loud speaker does not operate according to phase opposition, we did two things, the first thing, we show that our loud speaker is in identity with that held by Judge Morris not to infringe, and then we did one thing else, we located a person here in the city of Baltimore to whom, according to the records of the defendant company, one of these radio receivers had been sold some time ago and has been used in this lady's home continuously since then. We got in a taxicab, went out there, got that loud speaker and have it here in court, and I am going to demonstrate on that loud speaker, which is over there ready to be connected, that you do not get any hum in it whatever, no matter how those coils are connected.

Now, I do not know what the explanation is for this receiver that is here in court, as your Honor can see, they hase disconnected it, supplied a lot of additional wires and equipment. It may well be, and I have expert testimony to establish, that these additional wires and equipment have thrown that set completely out of balance, because our commercial receiver hasn't got it. It hasn't got it for each of the reasons that Judge Morris found avoided this patent irrespective of its validity, because your Honor will appreciate this, if defendants' receivers operated and eliminated hum because of phase opposition in these two coils 9 and 10, if both coils are connected so that the current flows through them both in the same direction, you ought to get a very substantial hum. If the coils are connected so that they flow in opposite directions you ought to get no hum. Now, I am going to show you on this commercial receiver that has not been touched, that it does not make any difference, and this is exactly the same test that was made before Judge Morris with the 104 loud speaker of the Radio Corporation, it does not make any difference whatever how the terminals of those coils are connected, conclusively establishing that we eliminate our hum, just like the RCA 104 eliminates the hum, eliminating it at its source, so that it does not occur in the circuit. I will satisfy your Honor on the matter of infringement one hundred per cent. If I do not, I deserve to lose the case.

The Court: Then you had better finish with that right now.

Mr. Darby: All right, sir. Mr. Dumont, will you take the stand?

Thereupon ALLEN B. DUMONT, a witness of lawful age, produced on behalf of the defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION.

By Mr. Darby:

The Witness: My full name is Allen B. Dumont. I was graduated in 1923 from the Rensselaer Polytechnic Institute with the degree of Electrical Engineer. Prior to that time, during summer vacations, I worked with the Telefunken Company, the Marconi Company, the Independent Wireless Company. At graduation from school I was associated with the Westinghouse Lamp Company as engineer in their research department and developed a number of tubes and circuits during that time. I was in the research department of that company for approximately two and a half years, when I was transferred to the production department and had charge of the production of radio tubes up until 1928. At that time we were making approximately 100,000 receiving tubes a day. In 1928 I left the Westinghouse Company and went with the De Forest Radio Company as chief Engineer and I was with that concern for approximately three and a half years in that capacity, during which time I had charge of the design of receiving sets, transmitting sets, radio receiving and radio transmitting tubes and television apparatus. Since that time up until the present I have been engaged in consulting practice and also development work, in work with cathode ray tubes and oscillographs. I am a Fellow of the Institute of Radio Engineers.

Mr. Darby: I offer in evidence what was Defendants' Exhibit No. 74 in the prior litigation. It consists of a schematic diagram of the loud speaker model 104, charged to be an infringement in that case.

The Court: Now, let me see. You do not make your argument reasonably clear to me. Isn't it possible without a lot of diagrams for this witness to go to the machine, or go to the board and tell me wherein they elim-

inate the hum, and if they do not eliminate it in the loud speaker, then your contention is upheld.

Mr. Darby: Yes, I will withdraw the offer.

The Court: After all, what is the use of the witness if he can not make it clear to me?

Mr. Darby: All I intended to do was to put in evidence the diagram of the RCA 104 loud speaker.

The Court: I do not want that. It doesn't do me a bit of good. You see the trouble, if I may respectfully say so, that most patent attorneys seem to fall into, is that they concern themselves most about making the record. I am not a bit interested in the record. I am interested in being told what is the difference in the machines, and if the witness can not tell me, why, then, there can not be any record. The first object ought to be to tell the trial judge what the difference between the machines is. Now, if Mr. Dumont can go to the board or go to this machine and explain to me that what you say is true, why, that ends the case on the question of infringement but if he has got to fall back on some diagrams or records in another case, then we are exactly where we were yesterday afternoon when I had difficulty in reading Dr. Lee's diagrams on the board.

Mr. Darby: I had just two objects in mind, your Honor, and I want to discharge them both in the manner that would be acceptable to your Honor. I want to establish by evidence that our receiver does not differ from the 104 receiver, and I also want to establish that we do not use this point, so I will go directly to the last point first.

Q. Will you please briefly state the circumstances under which you got the model 109, Stewart Warner receiver, which is here in the courtroom?

Mr. Edwards: I object to that as immaterial. This is not the machine against which our case is made out. There is the Stewart Warner receiver on the table against which we have directed our charge of infringement.

The Court: How did that one come into your possession?

Mr. Edwards: We bought it. It was admitted that we bought it from the defendant. It was manufactured by the defendant. Mr. Lowell testified this morning, or Mr. Dunmore, rather, showed by the way the connections were put in at the factory, and the machine is otherwise in the same condition that we got it—I mean otherwise except for the cutting of the wire and putting in the switch so that we could switch it from reverse coils to cumulative coils.

The Court: Why not let him go down and testify whether that is one of the defendants' machines? If it is not, point out where it is not.

Mr. Darby: Your Honor, it is one of the defendants' machines but they have taken it out of its natural situation. They have mutiliated it, added things to it, separated the parts and added wires.

The Court: They say they have not.

Mr. Darby: It shows on its face.

The Court: That ought to come from the witness, not from the attorney.

Mr. Darby: Absolutely. That is what I am asking and Mr. Edwards is objecting to it.

Mr. Edwards: I am not objecting to that. I am suggesting that he point out in regard to this machine here wherein there is anything about it to show the coils were not in opposition as we say.

Mr. Darby: I will come to that. I have got the 109 receiver in its marketable form and I want to establish that on the record and the circumstances under which it was acquired and then I will ask the witness to point out where their apparatus is not proper.

The Court: Very well, go ahead.

Mr. Edwards: I object to this other machine. As I understood it, from Mr. Darby, that is something that was put out some two or three years ago and it is not the machine against which the charge of infringement is directed here.

The Court: I think it would be helpful if you would use it by way of contrast.

Mr. Edwards: May I have an exception?

The Witness: We had brought a model of 106 receiver into court to demonstrate the fact that it did not make any difference which way the coils were connected. However, on coming into court we found that they were using 109 model instead of 106 and as that model was several years old we could not locate any in town, so we had to look up and see who had purchased the other receivers prior to that time, and we located a Mrs. Ruth Sobol of 3413 Wayne Avenue, Baltimore, who happened to have one of these machines. We went out and got the machine, borrowed it from her, and the only change that we made on this machine is to put two clips on the wires so that they could be reversed. We did not want to put switches in it, we did not want to take any wires out, like they have done on this set on the table, due to the fact when you make connections like that it would pick up hum and interference and you do not get a true test. You can observe from the back there, when you see the set, that it is in the original state that it was received from the company and it is not all torn to pieces. I will step over to this set and operate it and demonstrate whether or not hum elimination can be obtained. This wire (indicating) is the same as the wire that comes out of the back of the other set. This has four wires contained in it; two which go to the voice coil and two which go to the field coil. I did not know at the time we got this installed whether they were going to reverse both the voice coil and the field coil, so I put connections on each one of them in order to change both of them:

I put connections on to each one of them, in order to be able to change both of them. But, as long as they have only questioned the shifting of the field coils, it will be only necessary for us to shift the two connections which go to the voice coil, to prove whether there is any hum in the apparatus or not. Now, I can turn this on. I will first tune in a station, to show that the set is operating properly. It just takes a second for it to heat up.

(Set in operation.)

The Witness: Now, I will tune the set so that we cannot hear the station, and you can listen for the hum. There is absolutely no hum whatsoever in the receiver. Now, if Mr. Darby will just turn that off; I do not want to get

shocked when I shift this. I will shift these two connections to the voice coil and the receiver, and incidentally they are long enough to be shifted, contrary to the testimony given. They have not been changed. They are the original connections, and both the same way. I have shifted the two the opposite way, and move these so they would hit together. If you will just turn that on again, Mr. Darby.

(Set in operation.)

The Witness: Listen for the hum. There is absolutely no hum there. It does not make any difference which way you shift them, because the alternating current has already been filtered out by the filters, and there is no A. C. components going to the loud speaker. Now, I can tune this station in again, if you care.

(Set in operation.)

Just to show it is still operating. Now, this set has not been changed in any way from the way it was received. It is all together. Would you please leave that alone.

The Court: Now, can you come here and tell me where you eliminated it?

The Witness: Yes, sir. The hum is eliminated by means of a condenser which is inside of this case, and by means of choke coils underneath the receiver. They are actually in the receiving apparatus. That is the method of eliminating the hum. So there is no hum whatsoever that comes out of the set. It is common practice, and it is done in a lot of various apparatus.

I will now explain what different results were obtained with the model 109 receiver that the plaintiffs have set up on the bread board effect.

Different results were obtained with the receiver, probably due to the fact that it had been disassembled and mounted differently than it was mounted in the original case, due to the fact that various leads were taken out of the receiver and brought over to switches. Ordinarily these wires are inside of the shielded metal cabinet, so that no disturbances are picked up. It is obvious that when you separate out the wires, as has been done in that apparatus, that you are not sure of your results;

and whatever tests were made on the receiver to really determine its operation, it is always made exactly as the receiver is to be shipped to the ultimate consumer. It is not disassembled and a final check made on the parts spread out on a bench. It is a matter of common engineering and radio knowledge that wires connected to apparatus laid out in the open induce currents from one to the other. It is that fact which causes wires to be shielded in the modern radio apparatus.

Mr. Darby: That is all I have to say on that point, your Honor, and if I may come to the second point, unless your Honor has something.

The Court: I want to ask a question or two to get this more clear in my mind. Do I understand you, Mr. Dumont, putting it in laymen's language, to contend that in the defendants' device which you have just demonstrated, no hum passes out of the set, the receiver set?

The Witness: That is correct.

The Court: That you do away with that hum by what you call a filter method?

The Witness: That is right.

The Court: Do I understand, as has not been explained, but you inferentially maintain it is not necessary to explain that in detail, due, of course, to the contention of plaintiff; you say that you eliminate all hum before it gets into the loud speaker?

The Witness: That is correct.

The Court: And you are demonstrating that by showing that no matter how the wires are placed in the loud speaker or, as you call that, the coil——

The Witness: It is the loud speaker. The coils of the loud speaker.

The Court: ——the wires in the loud speaker are placed, whether in phase opposition or not, that you do not get any hum.

The Witness: That is true.

The Court: And from that you would have me draw the conclusion that while you do eliminate the hum, that

is, while your device accomplishes the same purpose as the plaintiffs' device, that you do it in an entirely different way and in an entirely different place.

The Witness: That is correct.

The Court: Namely, in the receiving set, and not in any way in the loud speaker.

The Witness: That is exactly what is done.

The Court: Is that a fair statement of your contention?

The Witness: It is.

The Court: Very well. Now, if that is true, then I suppose you would say that if the plaintiff has one of its own sets complete and in operation, and if they demonstrate that, and if they show that the same alteration of the wires in the loud speaker that you have made in your demonstration do not produce the result, namely, that by alternating wires in the loud speaker, in the hypothetical demonstration that I am now speaking of with plaintiff's apparatus if that alternating of the wires does not produce the same result in each case, that is, if the hum is eliminated in one case and not in the other, then, if I understand you correctly, you say that it necessarily follows from your demonstration of your client's machine that the two things must be different.

The Witness: That is correct.

The Court: Because while the result is the same that is accomplished under the suggested demonstration, that is, if the demonstration is made that I have just suggested, that machine of the plaintiffs does not show that the hum is eliminated, regardless of how the wires are changed on the loud speaker, that it necessarily follows from your demonstration that the elimination can not be produced in the same way.

The Witness: That is correct.

The Court: Is that a fair statement of what your testimony leads to?

The Witness: It is, your Honor.

The Court: Well, now, it seems to me right at this juncture I would like—I do not want to interrupt the sequence of your thought,—but I would like to have the plaintiff's answer to that. Why isn't that a self-evident thing? I am not attempting to say what such a demonstration would produce, but why isn't that the correct way to answer defendant's contention, and why isn't it the only conclusive answer, Mr. Edwards, that I could rely on? If I have not made my suggestion clear, I would like to restate it, because I am not attempting now to decide the matter at all; but I think I can get it very clearly, what the defendant's contention is. Whether it is sound or not I am not now deciding, but if I have correctly stated it, it seems to me that the best way, in fact, the only way that I see now that I can determine with any finality whether that contention is sound, is for the plaintiff to say to me in effect, listen to our machine, listen to our apparatus, let us alternate or change the wires in the loud speaker, as has been done by the defendant in this, and see what the result is. Now, if the result is not the same, then, unless there is some element involved which has not been talked about, or at least made clear to me in the last two days, doesn't it necessarily follow that the same result is being produced in an entirely different way, because in an entirely different unit, and, as I understand it, the inventor, one of the inventors, if not both of them, has said this morning that they claim no novelty except in the loud speaker; and then if such a result as I have outlined would be produced by that test, why wouldn't the best evidence be had of what is the true answer to the question?

Mr. Edwards: Well, I think your Honor's mind runs along very close lines to our way of looking at it. We came in, and we said that our invention consists in winding the coils, of the two coils of the loud speaker in opposite directions. We said, If you take a loud speaker and put it on a set operated by alternating current, you will have hum delivered into both coils and the receiver, and if you wind the coils in the same direction that hum will be loud; if, on the other hand, you reverse them, the two hums will neutralize each other, and you will not interfere with the signal. That was a very narrow compass. Well, yesterday and today we brought in a set, a Stewart-Warner set No. 109, admitted to be made by the Stewart-Warner Company; and Mr. Dunmore showed that the

set, as we received it, and as indicated by the length of wire to the coils, was made up with the coils in opposition to each other, and that when the coils were reversed you would get a substantial hum, but when put back into the condition in which the set was received, with the coils in opposition, you did not get the hum. We also this morning demonstrated on one of the plaintiffs' machines, that is to say, a machine made by one of the licensees under the patent in suit, and showed on that machine that by taking the coils as they stand in the machine you hear no hum, but by reversing them you do hear a hum. Now, I submit that is the test thus far. Now, as I follow the defendant's testimony, the defendant says in reality we have in our machine what we refer to as a Hull filter interposed between our receiver and our loud speaker, and that Hull filter takes the hum out of the set. Now, if I follow your Honor, I will say that I agree with you, that if the Hull filter takes all of the hum out of the set, then it may or may not make any difference whether the coils are reversed or not. It may be that there is no hum to take out when you get to the loud speaker.

The Court: Well, isn't that proved by demonstration?

Mr. Edwards: I think not, sir.

The Court: Well, I do not see how it can be proved any more clearly than somewhere before you get to the loud speaker it has been eliminated. I do not think I should be burdened with determining where it is eliminated, if you disconnect, so to speak,—if you make the same connection or disconnection at the loud speaker,—since the plaintiff has said that that is the only place in which they claim novelty.

Mr. Edwards: Well, now, sir, I think we have several answers to that. We demonstrated on this Stewart-Warner set here that there is hum both before and after it gets to the Hull filter; as it comes out of the Hull filter there is hum, and that is taken out by the reversing of the coils in this set, against which we made out our case. Now, the defendant comes in and says here is another Stewart-Warner set—Mr. Dumont, not the man who made it, not the Stewart-Warner Company, but Mr. Dumont comes in and says, "I traced a machine, and I brought this machine, and I found that in this machine I do not hear any difference whether the coils are one

way or the other." Now, he has criticized this one as not being good, because he says it is separated. We propose to criticize that and ask your Honor to make another test on that machine. They have put the cloth in the loud speaker, bundled it up, where you are not likely to hear this hum; and bear in mind, your Honor, we are listening to these speakers in a more or less noisy room. The real test for this is the person who is sitting in a quiet room, in a resonant room, and does not want to hear a loud, blatant signal, or a low one.

The Court: It does seem to me that prima facie I will have to give more weight to a machine that has been in commercial use—I am not saying this is the one, but I will certainly have to lay this down as the governing principle, that if I am satisfied that a machine is one that has been in commercial use and is here operated in the same condition that it was in commercial use, I will have to give more weight to its operation than to the operation of a machine which the plaintiff has gotten—I am talking now about the defendant's machine—which the plaintiff has gotten and has dismantled and set up in a way which is not a commercial way.

Mr. Edwards: We have not dismantled that machine in any respect, except to take it out of the case, where one can not make a good test. And, after all, I submit to your Honor there is a machine which it is admitted that the defendant has been selling. If defendant sells that machine, and it is an infringing machine, and if, as defendant says, it makes no difference which way these coils are connected, then surely it will do them no harm to stop connecting their coils in phase opposition. I have yet to hear, sir, a single statement or evidence or proof that the defendant does not connect those coils in phase opposition.

The Court: Well, now, next in order I would like to have Mr. Dumont explain what, in his opinion, is the difference that has been caused by the way this machine on the table has been handled or set up.

The Witness: You want me to go down to the machine?

The Court: Well, if you want to go there.

Q. (By Mr. Darby) You can stay there.

A. I do not think it is necessary for that. Your Honor will notice that out of the side of the chassis, that is the metal box which the set is mounted on, they have taken a number of leads out to the various switches on the bread board. Now, the receiver is designed so that all the wiring in connection with the radio receiving set is supposed to be inside this shielded metal box, to prevent any extraneous current, either alternating current in nature, or from elevator motors, or fan motors, or anything from being picked up. Now, they have taken those sensitive leads out and put them right on the board there where they are exposed, and it is impossible to tell just how the set would operate. It might operate entirely different in another location; another location might have a lot more electrical interference than this, and there would be no—you can not be sure of the operation of the receiver. And another thing they have done, instead of taking the voice coils directly to the loud speaker and putting, as we have done, clips on them, showing that there is not any difference, they bring it out in front of the loud speaker, put it near the other wires that are coming out from the receiver there; and it is impossible to tell just what condition you have in the set.

The Court: Have you put anything else in here at all?

The Witness: We have not touched that set in any manner. And I might say at this time that we have a 106 receiver at the rear of the room, which we originally tested, that only has two clips on it. We did not bother shifting the excitation coils of that. It has clips on just the two top coils. And we can take any receiver that is available in town and do the same thing with it, and you get the same result. We do not have to pick sets and we do not have to work over them. In other words, the receiver that I tested is in its normal condition and under normal circumstances. It is exactly the way it is used.

As to whether the receiver that the plaintiffs have used is in its normal condition and under normal circumstances, I will say that they do not certainly sell any receivers built up that way. The two receivers are not identical. The two pieces of apparatus are not identical. It is true that they are both 109 receivers.

The Court: Well, now, this is a little irregular, but I want to get this point cleared up. I am satisfied that the matter that would be of greatest probative value to me at this point right now is the demonstration by the plaintiffs' own machine to see whether, applying the same tests, the same or different results would be gotten. Mr. Edwards, I want to give you full opportunity to answer that question, but it seems to me that that is a conclusive answer to the question of whether they are similar in their operation, provided always the samples are accurate and are commercially proper samples. It seems to me to be a very simple proposition. If these are in proper working condition, it is fairer to listen to one of them and fairer to listen to the plaintiffs' machine in a similar case, than it is to listen to the defendants' machine set up by the plaintiff under conditions that it would never be sold under, conditions under which it would never be sold. Now, I do not see what the answer is to that.

Mr. Darby: Your Honor will recall that they made that demonstration this morning. They set up the Grigby Grunow machine, the Majestic machine, which they established was manufactured by one of their licensees, and showed that when the switch was on one connection you got no hum, and when it is on the other connection you get a substantial hum. They did that this morning. It has already been done.

The Court: Well, I want that example.

Mr. Edwards: May I ask, to be clear, if we will first demonstrate it on the Grigsby-Grunow machine?

The Court: That is the plaintiffs'?

Mr. Edwards: That is the plaintiffs' machine.

The Court: That is a machine commercially in use?

Mr. Edwards: Yes, sir. May I also suggest this, sir. This model which we produced and demonstrated this morning has been criticized because it is said the parts are separated. May we restore them by putting back in the case and testing that?

The Court: Very well.

Mr. Edwards: That is the one that we bought, mind you, in the ordinary course of commerce, as this was sold, as this machine was sold.

The Court: Well, how long would it take to put it back?

Mr. Edwards: About fifteen minutes.

The Court: Suppose you have that done while I am looking at the other.

Mr. Edwards: Very well.

The Court: Can you put that back so that it will be like the other one?

Mr. Dunmore: Yes, sir. It will take about twenty minutes.

(Set operated.)

Mr. Frederick Brady: There it is operating normally. The hum is very slight.

The Court: Can't you put the voice coil in so I will see the effect?

(Set in operation.)

The Court: I can hardly hear it at all.

Mr. Frederick Brady: The hum is very fine.

The Court: Now, put it over here again.

Mr. Frederick Brady: Perhaps you can hear it better in front.

The Court: I do not hear any difference.

Mr. Frederick Brady: It is very slight, but if you tune your ear to the 60-cycle pitch. That is normal operation. There it is reversed. I will leave it on for a few minutes. There are two noises, that crackling. There, can't you hear that hum?

The Court: Is that normal?

Mr. Frederick Brady: No, that is reversed.

The Court: Yes, I hear that.

Mr. Frederick Brady: There it is normal.

The Court: There is a little difference.

Mr. Frederick Brady: There is a difference.

Mr. Edwards: While we are restoring that set, you might, perhaps, go ahead with Mr. Dumont.

Mr. Darby: On the matter of restoring that set, your Honor, I do not want to be taken as acquiescing in an attempted restoration, because I do not know what has happened to that set. If it contains any hum at all, it is not the way it left our factory.

The Court: Well, I suppose the witness can tell whether it is being restored properly, can't you?

The Witness: I can not tell really whether it has been restored correctly without actually checking the various condensers and resistances in the set, and that is a question of taking a day or so, with the necessary apparatus to do it, to be reasonably sure that everything in there is as it left the factory.

Mr. Darby: Well, I will go onto the next point. My next point is to establish that our radio speaker is the same as the radio speaker which Judge Morris held to be not an infringement. For that purpose I must put in evidence the drawing of the 104 loud speaker, so I offer in evidence the drawing of the R.C.A. 104 loud speaker, which is typewritten exhibit 74 in the prior case.

The Court: I thought you admitted it was not the same, because it did not have the copper ring.

Mr. Darby: It was the same, with that exception, if your Honor please.

The Court: That is all we need to say about that.

Mr. Darby: That is all we need to say, but must I not have something in the record?

The Court: All right.

Q. (By Mr. Darby) Is my statement correct, Mr. Dumont, that the only difference between them, in so far as this case is concerned that in the present de-

fendants' loud speaker they omit the copper ring? A. Yes.

Mr. Darby: I offer that in evidence.

(Drawing referred to marked "Defendants' Exhibit A.")

Mr. Darby: I understood from your Honor's viewpoint that you consider infringement to be of importance, but I nevertheless put in issue the question of validity, and for that purpose I will offer in evidence Langmuir patent No. 1,282,439.

(Patent referred to marked "Defendants' Exhibit B.")

Mr. Darby: Hull patent No. 1,251,377, which was Exhibit A for Identification, and which will now be offered as C.

(Patent referred to marked "Defendants' Exhibit C.")

Mr. Darby: The White Patent 1,195,632.

(Patent referred to marked "Defendants' Exhibit D.")

Mr. Darby: Robinson Patent No. 1,587,084.

(Patent referred to marked "Defendants' Exhibit E.")

Mr. Darby: And the Pridham & Jensen Patent No. 1,105,924.

(Patent referred to marked "Defendants' Exhibit F.")

Mr. Darby: An- in connection with that Pridham & Jensen patent, if I may pass it up to the Court, I call your Honor's attention to the fact that this patent, which was applied for in 1913, and issued in 1914, is for a telephone reproducing device, such as the loud speaker is, and it advances at its invention opposite phasing of the coils of the loud speaker, to eliminate extraneous noises due to hum, and whatnot.

The Court: Where is that?

Mr. Darby: Right on the first page, beginning at line 41, "In instruments of the class wherein an annular movable coil has been employed it has heretofore been necessary to use direct current from either a primary or secondary battery when electro-magnets produce the magnetic field. When direct current from a dynamo has been used, a strong reaction takes place, owing to fluctuations of the current due to the commutator action. This reaction is caused by variations of the field strength which induces currents in the telephonic coil. These currents reacting upon the normal field strength produce the vibration which greatly interferes with the action of the instrument. Concerning the development of these induced currents in the telephonic coil, it can be shown that a decreasing field strength will produce an induced current in the same direction as the energizing current while an increasing field strength produces an induced current in the opposite direction to the energizing current. In the instrument under consideration we have used direct current with a high degree of success even when the fluctuations of current were strong."

The Court: Isn't it a sufficient answer to this to say that they are not dealing with alternating current?

Mr. Darby: No, sir, we are not dealing with alternating current either, after passing the rectifier, even in the patent, in ours it is direct current.

The Court: It is not the same sort of direct current. I understand you have admitted that, when you gave the demonstration on the board.

Mr. Darby: Well, I do not know whether it was Judge Woolley or Judge Morris who points out in his opinion—maybe it was Judge Woolley—in connection with the Patent No. 2, but as he points out, after you leave the rectifier it is direct current, and the source is wholly immaterial. Now, in the patent in suit it is direct current, our structure has direct current, and all of them have exactly the same problem thereafter, to smooth out the ripples that occur. Now, in the patent in suit those ripples that are in there are because of a 60-cycle hum. But this patent points out that our invention simply comprehends the use of a divided conductor, in each section of which is included the magnetic field, energized from the

source of fluctuating direct current. And that is what they have, and that is what we have, the sections being so connected together that the induced current can have no effect in actuating the diaphragm of the instrument. In other words, they are in opposed phase to each other. It is directed to exactly the same thing as the patent in suit.

The Court: That is the one you rely on primarily, is it?

Mr. Darby: An anticipation, yes, sir. And your Honor will recall that is the patent Judge Morris referred to, and because he says, because he disposed of the case on non-infringement it is not necessary to go into it.

I also offer in evidence the file wrapper of the patent in suit. It is in support of the second attack on the validity of the patent, because of all the claims. And this idea of opposed phase relationship of the coils was injected into the case, new matter, more than four years after the application was originally filed. That is all revealed from the file wrapper, and reviewed in the Judge's opinion.

(File wrapper referred to marked "Defendants' Exhibit G.")

You can take the witness for cross-examination.

CROSS-EXAMINATION.

By Mr. Edwards:

Q. Mr. Dumont, is it your testimony that if the field coil and the pot magnet coil of the loud speaker are wound in opposite directions and both coils are receiving a pulsating current, that the action, the cooperative action between the two coils would or would not tend to reduce the hum in the two circuits.

The Court: He says there is not any at all.

Mr. Edwards: I do not understand him to say that, no.

The Court: Isn't that what you said?

The Witness: I said in our receiver——

The Court: He is talking about his machine.

Mr. Edwards: No, I do not want to ask about his machine particularly; I am talking about any machine.

The Court: Do not let us get confused, Mr. Edwards. I do not want to talk about any machine. I have heard this machine, and I have to stand or fall on what I hear and see.

Mr. Edwards: Yes.

The Court: Now, unless you can controvert that testimony, I shall have to hold that there has been no infringement. And I do not want to hear about any machine except the machines that are now in this court room, nor am I interested now at this late stage in hearing about what he thinks about the effect. I have heard the effect of the two machines. I want to hear the effect on the third after it is put in the position relative to the other two. So we are just going over the whole thing again, and tending to confuse what is in my mind. All I want to hear from him now in cross-examination is something that bears upon his contention, which is, in a word, as I understand it—correct me if I misstate your testimony in summarizing it—that in the defendants' machine you claim there is no perceptible hum, no hum that is audible to the human ear after the voice or the signal gets into the loud speaker, and that, therefore, it makes no difference how you have the wires related to each other, or the currents related to each other in the wires in the loud speaker; whereas, with respect to the plaintiffs' device, you claim that the opposition is true, namely, that the elimination of the hum does not take place in the filter, or in any other part of the receiving unit, but takes place by reason of this phase opposition as tested by transposition of the wire.

The Witness: That is a correct statement.

The Court: Now, the case, Mr. Edwards, has got to stand or fall on that proposition, what he says, if substantiated by the weight of the testimony, or rather, if the plaintiff does not sustain the burden of proving infringement, which rests upon the plaintiff, then the plain-

tiff can not win. Now, therefore, while it may be interesting, it is just confusing at this point to go into a question of the science and the development of this science, and what this witness may have found in regard to some other machine. And I would like you to confine his testimony to these particular points.

Mr. Edwards: Well, now, I think my question, sir, leads very directly to that machine. May I have an answer to my question first? I am asking him as a general principle if he agrees or disagrees with the general proposition that if the two coils of the loud speaker are receiving pulsating current, and if those coils are wound in opposite directions, does that tend to neutralize the hum or not?

The Witness: I think the answer to that is exactly the statement that was just made, namely, that you can eliminate hum by having the coils connected so that you have phase opposition. That is one method of eliminating hum. The other method of eliminating hum is to take it all out in the receiver, don't allow any hum to get to the loud speaker. Those are the two methods.

As to whether or not I agree that in the patent in suit, or the plaintiffs' machine, where the current goes directly from the rectifier to the field coil of the speaker, and from the output of the receiver to the armature coil, when coils in that condition are wound in opposition, that that is one way of eliminating the hum, I will say that that is one way of eliminating the hum, but from the patent, as shown, with the extreme high amount of hum that must be there, it would be rather difficult to eliminate it entirely. It is true that in this machine which I have brought in, I claim that at the time the current leaves the rectifier, there will be a hum at the output of the rectifier alone. I make no question of that. It is true that I claim, that the filter element which comprises the field coil 81779 and the two condensers, eight microfarad condensers marked 81347, constitute a so-called Hull filter, which is effective to take that hum out. That filter removes the hum. It is common practice to do it. It is done in innumerable pieces of apparatus. It is correct that in this machine, which I have brought in this so-called Hull filter, takes out the hum, so that there is

no hum left to be neutralized in the radio speaker. That is my position.

The Court: Now, is that machine ready?

Mr. Brady: Yes, I would like to hear that.

(Set in operation.)

Mr. Brady: Yes. Now, this is Stewart-Warner model 109 apparatus, which has been removed from the test board and restored to its original cabinet. It is absolutely the same form as is sold on the market.

The Court: Now, let me ask Mr. Dumont, is that now set up as the other one is set up?

The Witness: From what I can see, it apparently is similar. Of course, I can not tell except without examining it.

Mr. Darby: Why don't you get it away from all this extraneous apparatus and set it up over there, where the other set was?

Mr. Brady: Yes, that is a very good suggestion.

The Court: Yes, that is a good idea. Couple it up over there.

(Set removed to another portion of the Court Room.)

The Witness: Do you want to put this same antennae on that I had, so we will have a comparative test?

The Court: I want to have it as near the other conditions as it can be made. Is it the same size machine?

The Witness: It is the same machine.

The Court: The same model?

The Witness: Yes, the same model.

(Set in operation.)

Mr. Brady: So that we may have our record there, will you put on the record that re-installed 109 Stewart-Warner machine has been removed to the identical test table as that occupied by defendants' model 109. And Mr. Lowell will now perform tests on the restored 109. Please tune in a station, Mr. Lowell.

Mr. Lowell: I have already done so.

Mr. Lowell: You are satisfied with the station, are you?

The Court: Yes.

Mr. Lowell: Would you like to have me reverse the voice coil?

Mr. Brady: If you please.

The Witness: You better turn that off. There is a live circuit there.

The Court: First, I want to hear the conditions. I want to make the test as parallel to Mr. Dumont's as I can.

The Witness: I just tuned in a station to see that the set was operating.

The Witness: I tuned in a station to see if it was operating, and then I detune it so that you can hear any hum if it was present, so that the music would not bother you.

The Court: Is it detuned now?

The Witness: Yes.

The Court: Where should I put my head?

The Witness: Right there.

The Court: What connection is wrong in there?

Mr. Lowell: The connections are now as they were when the receiver was received by me.

The Witness: There is a large amount of hum in there now.

The Court: Well, what I mean, are they in phase opposition or not?

Mr. Lowell: They are in phase opposition, yes, sir.

Mr. Edwards: At the present time?

The Court: At the present time?

Mr. Lowell: Yes.

The Court: Now, change it.

The Witness: That is there, Judge. I mean that is an extremely high hum. We did not have anything like that. There should not be any.

Mr. Lowell: The voice coil is now connected in the reverse direction than what it was a minute ago.

Mr. Edwards: The coils are now which way, cumulative or in opposition?

Mr. Lowell: The two coils are cumulative now.

The Court: Now, will you put it back the other way?

Mr. Lowell: Now, it is back in the original position.

The Court: Well, it is much milder.

The Witness: It is much milder, but the set would never be shipped from the factory in that condition, a set that has as much hum as that.

Mr. Darby: You mean when connected in its normal condition?

The Witness: Connected either way. It does not make any difference.

Mr. Darby: Is there something wrong with that particular set?

The Court: Well, now, can you quickly put the other one back here?

The Witness: Yes, sir.

The Court: Now, that I have my ear tuned to it, I want to hear the other one.

(Other set placed on table.)

(Set in operation.)

The Witness: I will first tune in the station. Now, you can listen to the hum that is in the receiver.

The Court: Now, what is the condition of this one now?

Mr. Darby: This is in——

The Witness: Well, this is, I think it is in phase opposition.

Mr. Darby: What they call phase opposition. No, it is in——

The Witness: Yes, it is. I think so. I will know after I make the next test.

The Court: All right, make the next one.

The Witness: Have you an idea of how much hum there is there now?

The Court: Yes.

The Witness: I will turn this off and let him reverse it, if you do not mind. I want to be sure that the connections do not hit the coil there.

The Court: Now, can you change it once more?

The Witness: Yes, just a second, I will turn this off. It is off now. I will put it back to the way it was originally when we started this test.

(Set changed.)

The Witness: It is on now.

The Court: All right.

Mr. Edwards: Is there any objection to removing the cloth from its face so that we may hear?

The Witness: I do not see what that has to do with it.

The Court: Is this different from the other one?

The Witness: This is a standard model case this way. I see no reason for taking it out.

Mr. Edwards: The question is not what is different between this and this, but the question is whether the coils are in one condition in this set, if there is a difference, when the coils are in the opposite position in the same set, became, if putting them in opposition does reduce it, then the extent to which they reduce it is the plaintiffs' invention. Now, in some sets it is a commercial matter, if they sell a very cheap set. Some can stand more.

The Court: But I can not see any point in taking this off, unless you take it off of both of them, unless there is a different grade of felt.

Mr. Edwards: There is no objection to taking it off. But the one which we tested had this very pronounced, when the coils are one way or go the other way. And the point is made that in this set which they have brought in that there is no particular difference between the output, whether the coils are in one position or in the other position. Now, we are asked to judge that by ear only. And what may seem to us to be an unobjectionable difference may be a very important one commercially in better sets. The point is whether there is a difference between the coils in one condition or the other, in one set, rather than to test merely the hum in one set and in the other.

The Court: Well, I would like to ask a couple of questions in connection with that.

(The witness then returned to the stand.)

The Court: Mr. Dumont, have you any explanation to give, any reason to give for these two sets being of identical models, presumably having had a different amount of use, or probably so? Is there any reason in your mind why one should operate any different from the other?

The Witness: There are several reasons that will cause difference in operation. If the tubes are not correct—by that I mean if there are any of the tubes which have low emission, or other defects, they will introduce distortion and hum in that set. The other thing that could cause the difference is the fact that possibly the position of some of the elements at the bottom of the machine have been shifted in experimenting with it, or that there possibly may have been some values changed under there.

The Court: Some of the what?

The Witness: Some values of the inductances and resistances have been changed.

The Court: How would that happen?

The Witness: By experimenting with the set, and possibly applying incorrect voltages to it. They have the terminals brought out, and they were making various tests on it; and if by any chance the incorrect voltages were applied on the set, it would change the resistance or change the capacities inside the set.

The Court: That is all?

Mr. Edwards: Just a minute, I am not through.

Mr. Darby: May I offer in evidence the receiver?

Mr. Edwards: I object to it as immaterial, and not established.

The Court: Objection overruled.

Mr. Edwards: May I have an exception, please, sir?

The Court: Yes.

Mr. Darby: They will be Exhibit H.

(Receiver referred to marked "Defendants' Exhibit H.")

Q. (By Mr. Edwards) Mr. Dumont, as between two different sets of the same model, one may have more output than the other by reason of different tubes or some part dampening the connection as a whole, might it not? A. The receivers as manufactured are all tested and they must have a certain sensitivity before they are shipped out of the factory, within very narrow limits.

Q. Well, that is not my question, sir, as to what the manufacturer does. I am asking that as between two different sets, if you might have two sets of the same model, if one set happened to have bad tubes, or some part that is dampening the circuit, in that case you might get less output in the model after use, or more output in the other, might you not? A. Yes, that is true.

Q. Now, in the same set, however, is there any cause that would make the set hum more if the field coils are reversed and put into one condition, than it would if the coils were put back in to the cumulative position? A. Why, certainly, we have agreed on that.

Q. That is to say, in the same set, the test would be simply reversing the coils? A. That is right.

The Witness: I am not connected with the plaintiff company. I am not in the factory. I did not design any of these sets, nor superintend their manufacture. I think I saw this set the first time yesterday.

The Court: You said you were not connected with the plaintiff company.

Mr. Edwards: The defendant company, I meant, with the defendant, or the Stewart-Warner Company.

The Witness: No. I am not connected with either the defendant or Stewart-Warner and I am not in the Stewart-Warner factory, and do not follow their machines. It is true that I said that this set which I brought in was the same as the 104 loud speaker that was in the former litigation, except for the presence of the copper ring.

Q. Do you know if the armature coil, that is, the coil connected to the output of the receiver, the armature coil of the loud speaker and the field coil of the loud speaker were wound in phase opposition to each other or not? A. The only thing I know about that is the previous testimony in the case; and it was brought out that there was an attempt made at the factory to connect it one way or the other.

Mr. Edwards: Well, now, I am not asking him for his secondary knowledge, and I ask to have that answer stricken out. Your Honor, I ask that the answer of the witness be stricken out, if you please.

Mr. Darby: I object to the striking out of the testimony.

The Court: I will allow it to stand.

Mr. Edwards: May I have an exception?

The Court: Very well.

Q. (By Mr. Edwards) You never saw that speaker, the 104 speaker that was in that other litigation, did you? A. I did not see the other 104 speaker, but I have used plenty of them.

Q. Now, that answers my question. I am speaking of the one that was in that litigation. A. I did not see that one.

Q. And you have no reason to say that the coils of the speaker in that 104 loud speaker were in phase opposition, have you? You have no reason to assert of your own knowledge that they were? A. No, sir.

Q. You have no personal knowledge yourself as to the practice in the Stewart-Warner Company in actually winding their coils, have you? A. No, sir.

Mr. Edwards: That is all that I have of Mr. Dumont, but I would like to ask the defendants and your Honor for permission for our experts to look at the radio set that was brought in here by the defendant, and to make some tests ourselves. We believe that we can show your Honor that there is a pronounced difference between the coils when connected.

The Court: You mean you want me to listen to it again?

Mr. Edwards: I want to let our experts make some tests of the receivers which ~~they~~ brought in.

The Court: All right, that is all, Mr. Dumont.

Mr. Darby: That is all, Mr. Dumont.

(Examination of witness concluded.)

The Court: Do you want to make the tests now that I can hear?

Mr. Edwards: Yes.

Mr. Brady: We would like to have the gentlemen look at it, and then make our tests.

Mr. Darby: I am certainly going to object. They can have the receiver, but I do not want them to alter one thing about it.

The Court: I thought the tests had just been made. Mr. Lowell made them.

Mr. Edwards: Oh, no, Mr. Dumont made the tests, I believe. I do not understand Mr. Lowell did.

Mr. Brady: I would like to have Mr. Lowell have the opportunity to inspect the apparatus closely.

The Court: Oh, you are talking about the apparatus that was brought in.

Mr. Brady: Yes.

Mr. Darby: You can inspect it, but I do not want you to change it from its present commercial status to something else.

Mr. Edwards: It is not its commercial status.

The Court: You say it is not its commercial status?

Mr. Edwards: I insist there is nothing to show that. Mr. Dumont simply saw this yesterday and brought it in from some place where he says he found it.

The Court: If that evidence is not contradicted I have to accept it. The machine works—I listened to it —and it gives good music and voice.

Mr. Edwards: It is a Stewart Warner set, perhaps, but it is not the set complained of.

Mr. Darby: It is one of the sets complained of. They complained of set 109, and here it is.

Mr. Edwards: If these coils are not in phase opposition we have no complaint.

Mr. Lowell: I want to make sure that the moving coil is perfectly free to move in the air gap because I have seen such instances where a slight friction on the moving coil would effectively suppress hum but reproduce signals.

Mr. Brady: Can you make that inspection?

Mr. Lowell: If I can get at the front of that.

Mr. Brady: Can you do that merely by removing the speaker unit from the case? There are three nuts you have to move.

The Court: Go ahead.

Mr. Darby: I would like to have it noted in the record before he does that that you can tell from an inspection of the equipment that it has never been taken out of the cabinet since its purchase.

The Court: Why do you have to take that apart?

A. To get at the moving coil which is behind that cloth at the present time.

Mr. Darby: This is an exhibit that I would like to keep intact.

Mr. Brady: Then the easier way would be to cut the front cloth.

The Court: You can replace the cloth. Go ahead and cut the cloth.

Mr. Darby: We have to return the set.

Mr. Dunmore: Take those three nuts out and pull it out. You can preserve the set intact.

Mr. Brady: While we are waiting there is a second test I would like to have, which is the determination of the quantity of hum. We have a test apparatus here which will show us the amount of hum available in a set, and if your Honor permits Mr. Lowell to make two connections to that set he will demonstrate the amount of hum in the set.

Mr. Lowell: This set is all right.

Mr. Brady: Now, will you permit us to run the test?

The Court: Is that all right?

Mr. Lowell: Yes. I am satisfied as to the condition of the air gap.

The Court: Now, what is it that you want to run?

Mr. Brady: I want to run a filter test to determine the amount of hum in the set. It is a very simple test which will take a very short time. We have not proceeded with that test pending your decision, your Honor.

The Court: How long will it take?

Mr. Brady: A very short time. I should say five minutes.

The Court: All right.

Mr. Darby: Do you want this loud speaker left disconnected, or shall we connect it in again?

Mr. Brady: Let it lie on the table disconnected.

Mr. Darby: I likewise offer to complete my case, under stipulation by counsel for plaintiffs and defend-

ants that it be accepted in the present case with the same force and effect as though given in the present case, the following testimony relative to patent No. 1,606,212 given in the District Court of Delaware in the case of *Dubilier Condenser Corporation, et al. v. Radio Corporation of America,* the same being contained on the following pages in the typewritten transcript of the record in that case: Pages 187 to 206, inclusive; pages 370 to 382, inclusive; pages 883 to 886, inclusive; pages 1417 to 1444, inclusive; pages 1575 to 1581, inclusive; pages 1745 to 1748, inclusive; pages 1764 to 1772, inclusive, page 1817; pages 2016 to 2025, inclusive and pages 2079 to 2082, inclusive. I might say that that testimony is all directed to this very same thing, in one phase or another. It is all limited to this particular patent and the expert testimony is that in the modern radio receiver it does not make any difference what the phase relation is, if they use a hum filter, i. e. using a filter to eliminate the hum or to smooth out the current. That is a method of prevention. The patent in suit is directed solely to allowing the hum to be there, and then bucking it out. That is the method of cure. The two methods are entirely different. The patent in suit is directed to the second and limited expressly to the second method.

(The stipulated testimony follows:)

FREDERICK W. LEE, a witness called by the plaintiffs. (Being the same Frederick W. Lee who testified in the present case.)

DIRECT EXAMINATION.

Q90. I hand you a copy of Plaintiffs' Patent No. 1,606,212 and note that the patent states at page 1, line 17, and following, that one of its objects is to provide a circuit arrangement for a thermionic vacuum tube amplifier employing a loud speaking reproducer, in which the loudspeaker has its field winding energized from a source of residence lighting power without the use of primary or secondary batteries. Now what type of loudspeaker is it that has a field winding, as referred to in that part of the specification? A. A loudspeaker which has the field winding in the specification is commonly called an electrodynamic loudspeaker.

Q91. And just how does that type of loudspeaker function in reproducing sound? A. This type of loudspeaker may be divided into two separate portions. The first, we will call the field of this speaker, and the second,

we will call the armature of this speaker. The field of this speaker derives its strength from a current, preferably a current of such a nature which would cause no variation of the field in this speaker, and the armature derives its energy directly from the audio source which is generally a tube amplifying audio-frequency.

Q92. What is the difference between an electromagnetic loudspeaker and the permanent magnet type? A. The electromagnetic loudspeaker differs from the magnetic type in that the magnetic type has its source of magnetism in the residual magnetism of the core; whereas, in the electromagnetic type, the magnetism is secured by current; and therefore is of a much stronger nature than that of the type which does not use an exciting winding and functions much better for that reason.

Q93. In just what respect does it function better? A. It functions better for the reason that the amount of force applied to the moving diaphragm or cone depends upon the product of the field strength in the magnetic portion of the circuit, and the current in the armature portion of the circuit, and anything which would raise the strength of the magnetic portion of the circuit will thereby give a larger force than it would have had if it were not so.

Q94. Will you translate that last answer into the effect on the sound given out by the loudspeaker? A. The effect on the sound introduced by the loudspeaker, if you apply audio currents to the armature, is much more intense in the electrodynamic loudspeaker, which has a method of deriving its magnetism from a separate exciter winding than one in which it would not be present.

Q95. And what difficulties are present, if any, in operating the loudspeaker of this electromagnetic type in conjunction with an amplifier from alternating current? A. The difficulties introduced by operating a loudspeaker of electrodynamic type from an alternating current source, is due to the hum introduced by this method of excitation for the following reasons: First, the hum which is produced by the alternating current in the audio stage of amplification of the circuit, is produced in the horn in amplified condition; 2. The variation of the current through the plate circuit of the audio amplifier

also produces a hum when transferred to the armature of the electrodynamic loudspeaker. 3. The hum which is introduced by the exciting winding upon this electrodynamic loudspeaker is also reflected in the movement of the armature of the cone.

All of which both the variation of the current in the armature due to the alternating current as well as the variation of the current in the field due to alternating current tend to produce hum.

Q96. Referring to this diagram which I hand you, will you trace the circuit indicated in red on Fig. 1 of the patent stating whether that correctly describes the path of travel of the output circuit?

Mr. Barus: Is that simply Fig. 1 of the patent?

A. The current path in the audio amplifier output circuit designated in Patent No. 1,606,212 derives its alternating current power upon the alternating current supply at the terminals marked 27 and 28. Upon this primary winding 24 so connected to the alternating current power supply is also wound a secondary winding 21.

This secondary winding 21 serves as a source of energy for the plate circuit of the vacuum tubes and through it also the armature of the loud speaker. The raw alternating current from the terminals 21 is rectified by the coil 17 and the condenser 16 before it is applied to the plate circuit of the vacuum tubes 5 and 7.

The audiofrequency transformer 8 serves to couple up the plate circuit through the armature 9 of the electrodynamic loud speaker.

Mr. Neal: I offer this diagram in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 32.")

By Mr. Neal:

Q97. Will you state what means is provided in the patent for eliminating hum in this output circuit making use of the diagram which I now hand you, if you will? A. The neutralization of hum in the output circuit of Patent No. 1,606,212 is shown to be of two parts, first

the elimination of hum which might be introduced by the plate circuit and second the elimination of hum which may be due to the alternating current applied to the filament excitation. For the elimination of hum in the plate circuit there is provided the inductance 17 and the condenser 16 for rectifying the alternating current from the rectifying tube 18.

In the second portion of this circuit is shown a potential connection between the grid and the filament by the potential divider 11, which allows the application of a compensating potential between the grid and the filament for the elimination of hum introduced by the alternating current to the filament of the amplifier tube.

Mr. Neal: I offer the last-mentioned diagram in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 33.")

By Mr. Neal:

Q98. Will you describe the field winding current path in Fig. 1 of the above-patent making use of the diagram which I now hand you. A. The field current derives its source in the primary of the transformer designated as 27 and 28. This transformer has a secondary winding 24 connected through the rectifying tube 14 to the field winding of the electrodynamic loud speaker 10.

Mr. Neal: I offer this last mentioned diagram in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 34.")

Q99. I hand you another diagram and ask you to describe in what ways hum is eliminated from the field winding circuit, using this diagram if you wish? A. Hum which was introduced by the alternating current in the field winding 10 of this coil is eliminated in two ways, first, the inductance of that coil serves to even out the fluctuations of the current in that circuit, and second, the nature of the field itself tends to reduce the variation of the magnetic field in that circuit by the fact that the magnetic variations are not carried to the center portion of the field but distribute themselves under the field and

the operation of the armature is in the position not affected by this skin effect and the result is that the variations of the rectified circuit is thereby reduced before it enters into the armature 9.

Mr. Neal: I offer in evidence this last mentioned diagram.

(Received in evidence and marked "Plaintiffs' Exhibit No. 85.")

By Mr. Neal:

Q100. The patent says something about the opposing effects between the coils 9 and 10. A. There is a further method of eliminating the hum which exists in the armature and the field by so adjusting the various degrees of hum in the armature and the field that they may have a tendency to compensate each other.

Q101. Will you explain more fully what your previous answer related to when describing the skin effect and magnetic variations which did not affect the operation of the speaker very detrimentally? A. In an electrodynamic loud speaker having a solid core, around which is wound an exciting winding carrying alternating current, the effect of this alternating current is to produce a current in the core itself of such a nature as to oppose the magnetic motive forces introduced by the exciting winding and thereby neutralize the effect of the alternating current in the field winding itself. This current does not have to penetrate to the center of the core or the field, but it only enters a very small amount into the core itself. The higher the frequency the less the extent into the core.

Q102. This coil 10 of plaintiffs' patent does not have alternating current on it, does it? A. Plaintiffs' patent has direct rectified alternating current on it which is composed of a direct current upon which is superimposed an alternating current and the direct current portion is not influenced by the construction of the exciter and only the alternating current portion is allowed to be removed by this effect, thereby neutralizing the effect of the direct current and keeping a constant field and at the same time eliminating the effect of the alternating current in this field.

Q103. What part of the magnet 10 of the patent does the useful pull which affects the coil 9 come from, the inside or outside? A. The effect of the pull of armature 9 is affected from the portion of the field which comes from the inside of the coil.

Q104. And these variations which you speak of affect the outside of the core more particularly? A. The variation of the field in this core is at the outside portion of the core and not in the center portion of the core.

Mr. Neal: I offer in evidence a circuit diagram of defendant's loud speaker 104, which is stipulated to be accurate in so far as it goes.

Mr. Barus: Accurate in so far as it goes, but not complete; whether the details in which it is not complete are important or not I do not know at this stage of the case.

The Court: Then what is your desire? Do you intend to oppose the admission?

Mr. Barus: I am perfectly willing to let it go in.

The Court: But merely explaining your attitude?

Mr. Barus: Yes.

(Received in evidence and marked "Plaintiffs' Exhibit No. 36.")

By Mr. Neal:

Q105. Now, referring to Plaintiffs' Exhibit No. 36, do you find in that diagram an amplifying tube in combination with a loudspeaker of the electrodynamic type? A. There is an amplifying tube in connection with the loudspeaker, which loudspeaker I will call A, and an amplifying tube which is connected with it, which I will designate as B.

Q106. Now, will you trace the output current path of the amplifier tube, using these diagrams which I now hand you, if you wish. A. The output current path of the last tube leading into the loudspeaker derives its potential from the condenser C, which applies the positive polarity to the tube B at the plate. This tube B has been modulated by audio-frequency from an input circuit C, and the current follows through this plate to

the potential divider at the point D, thereby applying a voltage existing between the points E and D, which is not the full voltage of the rectified system on condenser C, but a portion F D has been taken off.

Q107. Will you continue with your last answer to trace the circuit from the amplifying tube B around through the remainder of the connections to the armature coil of the loudspeaker. A. In the plate circuit of the tube B is connected a transformer which I will call G, having on it a secondary H, which in turn is connected directly through the armature I of the loudspeaker.

Q108. You stated that the potential for this output circuit was derived from a condenser C. Will you state just how that potential is applied to this condenser back toward the source? A. The condenser C′ derives——

Mr. Neal: The witness marks the input circuit C′ instead of C.

A. (continuing) Condenser C derives its potential from the alternating current source which I will call 1 and 2 serving as a primary upon the transformer 3. The transformer 3 has a secondary which I will call 4 connected to two rectifying tubes which I will call 5 and 6. These two rectifying tubes 5 and 6 serve to make use of wave rectification and this rectified alternating current is supplied to the condenser C through the field winding of the electromagnetic loudspeaker and the filtering device which I will call 7. The tubes 5 and 6 receive their filament excitation from the exciting secondary which I will call 8. In this rectified alternating current is the potential of the condenser C.

Mr. Neal: I offer in evidence the diagram which the witness has just described.

(Received in evidence and marked "Plaintiffs' Exhibit No. 37.")

By Mr. Neal:

Q109. Will you describe what means, if any, are employed in this output circuit just described for eliminating hum making use of this further diagram if you wish? A. This diagram of loudspeaker No. 104 shows a neutralization of hum in the output circuit by applying a neutralizing potential to the tube B. This alternating

neutralizing potential is secured from the tap on the secondary of the winding of the transformer which excites the filament B. This tap I will call 9. In this way there is a compensating potential applied between the grid and the filament of the tube B which has a property of eliminating hum in this tube.

As will be noticed, there is also a condenser C which of itself is a rectifying device and has a tendency to keep the plate of tube B at a constant potential, both of which are hum eliminating methods.

Mr. Neal: I offer the last mentioned diagram in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 38.")

By Mr. Neal:

Q110. Will you compare the methods of eliminating hum in Plaintiffs' Exhibit 33 showing plaintiffs' patents output circuit with those of Exhibit No. 38, as to differences and similarity? A. Comparing Plaintiffs' Exhibit 33 to that of Plaintiffs' Exhibit No. 38, the patent circuit 1,606,212 has two methods of eliminating hum. The method is of applying a compensating potential to the tube 7 from a potential divided 11, this latter potential divided being placed across the filament terminals and serves to apply the compensating potential to the tube in the tube in the patent.

The loudspeaker of the Plaintiffs' Exhibit No. 38 applies a similar compensating device on the audio tube. Also the patent shows a condenser 16 and 17 for eliminating the hum in the plate circuit and the Plaintiffs' Exhibit No. 38 shows the choke coil of the loudspeaker and the condenser C, together with condenser C' as hum eliminating means.

Q111. Will you describe the field winding current both in defendant's loudspeaker 104 referring if you wish to this diagram which I now hand you? A. The current path of the field winding of the 104 loudspeaker derives its power from the alternating current supply of the system which I will call on this diagram primary terminals 1 and 2. It has a secondary winding 4 connected through the rectifying tubes 5 and 6 which apply the

rectified circuit to the condenser 7. This condenser 7 in conjunction with the condenser C and the field winding of the loudspeaker are the rectifying portions of this circuit. This rectified portion in turn supplies current to a potential divider system which I will call E F so that the current which normally flows through the field winding of the electrodynamic loudspeaker is that supplied to the condenser C as well as that going through the potential divider E F.

There is therefore the smoothing action of the rectifier incorporated in the field winding of the electrodynamic loudspeaker and ripples which come through this winding in the form of higher frequencies pass partially through the condenser G, so that in this circuit the field winding acts also as a rectifying device for the alternating current supply to the plate circuit.

Q112. What do you mean by "rectifying device" as stated in your last answer? A. The rectifying device in this circuit consists of the condenser 7, the field winding of the coil and this condenser C.

Q113. Is that a rectifier in the sense that it changes the alternating current into direct current? A. The purpose of the rectifying device is to change the variable potential as supplied from the alternating current transformer 4 through the tubes 5 and 6, to a system which alters the variation normally present in alternating currents to the constant potential which is found to be at the condenser C.

The Court: Do I understand the answer to the question is yes or no? Read the question.

(Question repeated.)

The Witness: I beg your pardon. What are you talking about, this exciting field?

Q114. You referred to the field winding of the loudspeaker as a rectifier, and I was wondering whether you were using the word "rectifier" in the sense of something which converts or changes alternating current into direct current? A. No, that rectifier serves to iron out the frequencies which exist.

Mr. Neal: I offer this last mentioned diagram in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 39.")

Q115. How does this further diagram which I now hand you, compare with the description which you gave in your preceding answer as to the parts of defendant's field circuit which serve to reduce hum? A. The field circuit of the exciter serves to reduce hum in this system in their way similar to that of the patent No. 1,606,212. The choking action of the coil tending to keep the current constant through that coil helps to reduce the hum, and it also has the property of keeping the magnetism of this core uniform by what I would call the skin magnetization of the coil. In addition to this, there is a small condenser at the beginning which helps to prevent the variations from reaching the exciting winding of the horn.

Mr. Edwards: Suppose you identify that.

The Witness: This last condenser we will call 7.

Mr. Neal: I offer this last mentioned diagram in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 40.")

By Mr. Neal:

Q116. Now, referring to Plaintiffs' Exhibit No. 40, do you find that the armature and field coils of the loudspeaker are connected in such a way as to produce an opposed phase reaction tending to neutralize hum, or otherwise? A. The circuit as indicated in the loudspeaker 104 for neutralizing hum between the armature and the field circuit may be existent, but need not necessarily be present, since there is polarity indications on this diagram showing the care with which the armature should be connected to the transformer, which I will call G. If there were hum elimination because of the compensation polarity arrangements would have been indicated. I take it that this system may operate on the principle of removing hum, but not necessarily be using that principle with this circuit.

Q117. Do I understand your answer to be that that phase opposition is not necessarily present? A. The phase opposition may be present, but not necessarily so.

Q118. Now, turning back to the operation of the loud-

speaker shown in Plaintiffs' patent, what portion of hum does the phase opposing action act upon? Is it all of the hum or only such as has already been acted upon by the coil 10? A. The phase opposition of the plaintiffs may be considered to be a refinement of the extra elimination of hum which can not be taken care of by the compensating device, and also the exciting winding and its reactions in the circuit.

Q119. The exciting winding being— A. The exciting winding being No. 10.

Q120. From the technical standpoint what weight would you give to the fact that plaintiff's circuit includes two rectifying devices for tubes 14 and 18 for supplying rectified potential to the system while defendant's system derives its potential from the same full wave rectifiers which you have referred to above? A. The Patent No. 1,606,212 shows two sources of rectified current, one for the plate and a separate one for the exciter. There is no reason why the same source of rectified alternating current could not be applied to both the exciter and the plate circuit of the system which has been incorporated by the plaintiff's Exhibit 36.

Q121. My question was intended to bring out whether or not you regarded that as an important difference from the technical standpoint. A. From the technical standpoint there is no difference.

Q122. Does that difference involve any question as regards the size of rectifying tube employed? I mean would you employ a different power of tube for the whole system from what you would employing separate tubes for the two parts of the system? A. I would use a tube of sufficient size to take care of the proper amount of rectified current necessary to operate both in case I was just using one unit.

Q123. And if two rectifiers were employed, how would their comparative size be? A. Their comparative size would be sufficient to meet the demands of their respective circuits.

CROSS-EXAMINATION

XQ501. Referring to Patent No. 1,606,212, the patent states at page 2, lines 61 et seq. the following:

"In spite of the fact that the sole source of power for this circuit is from the 60-cycle alternating current source, there is practically no resultant hum in the loud speaking telephone due to the reactance offered by the

winding 10 and the cooperative effect of this winding with the output circuit of the amplifier system. That is to say, the inductance of the field coil 10 is selected of such value and the power amplifier is so connected with the winding 9 that pulsations in the field winding are effectively opposite in phase to the phase of the pulsations in the output circuit of the amplifier so that there is a tendency for the disturbing currents to be neutralized as a result of which the armature remains stationary so far as the effects of disturbing current components are concerned."

Do you understand that there are disturbing pulsations in the moving coil of the 104 loud speaker? A. From the diagram submitted of your circuit I could gather that there could be disturbances of this kind, but I can also infer that it may not necessarily be present.

XQ502. Have you ever seen or tested a 104 loud speaker to determine whether or not they were present? A. We have reversed the polarity on your 102 loud speaker which does not really imply that the polarity with the currents in the two circuits are 180 degrees out of the phase, and there may not be any compensation due to the difference in phase between those two currents, and we found that there was no difference in hum, but it need not necessarily state that the principle of compensation as exists between the field winding and the armature winding is not present in that circuit.

It also might be inferred that the variations which exist in that thing may be of a too small magnitude to be observed by making the interchange of connections to show whether there was a variation. There may be also the case that you have smoothed out the variations so that it was not necessary to compensate in this way.

XQ503. If there was any such variation present, as I understand your testimony, they were so small as not to be appreciable, is that right? A. I did not carry on very refined tests, and I only utilized the ordinary audition.

XQ504. The differences were not such that you could determine by ear whether or not this effect existed in the 104 loud speaker? A. I could not detect in my ear that such a condition existed.

XQ505. What other method, if any, for eliminating hum in a loud speaker connected to a power amplifier is disclosed in Patent No. 1,606,212 and in answering that question please point out the lines of the specification to which you refer as giving such instruction. A. The portions of the patent which specify hum elimination are as follows: On page 1, line 17, reading as follows:

"A further object of the invention is to provide a circuit arrangement for a thermionic vacuum tube amplifier employing a loud speaking reproducer in which the loud speaker has its field winding energized from a source of residence lighting power without the use of primary or secondary batteries.

"A still further object of the invention is to provide means for eliminating the hum of the low frequency alternating current power supply in the circuits of the thermionic vacuum tube amplifier and reproducer."

"Another object of the invention is to provide means for rectifying alternating current and smoothing out the rectified energy to provide a source of power for the circuits of the thermionic vacuum tubes and loud speaking reproducer."

The details of the circuit and things of that kind are understood in the following portion, line 49: and it will be understood that I am not interpreting patents, I am not interpreting the art in this interpretation of what I gather is the art employed:

"It will be understood that the principles of our invention may be embodied in various forms and that details are not material. The present embodiment of the invention, therefore, is to be considered as merely indicative. The form illustrated in the drawing and hereinafter described in detail has been found to be one of the practical embodiments and capable of efficient operation and practical in construction."

On the same page, line 65, it says as follows:

"The unit includes a plurality of thermionic vacuum tubes connected in circuit for audio frequency amplification. The loud speaking telephone may be of the type employing a coil armature and electromagnetic field coil."

Further down in the page, at line 80:

"Rectifiers are employed in the unit whereby energy derived from other windings is rectified and supplied as a source of plate circuit potential for the vacuum tube amplifier and as a supply for energizing the field of the loud speaking reproducer. The rectifiers are preferably of the two electrode valve construction and have their filaments energized from other windings on the transformer. Means are provided for biasing the grids of the vacuum tubes comprising the amplifier. Means are also included in the circuits of the amplifier for eliminating the hum from the alternating current power supply and means are included in the equipment for smoothing out the rectified energy supplied to the plate circuits of the amplifier."

It reads right down to line 97.

Then at the bottom of page 1, line 110, beginning with the last word on that page:

"The purpose of stabilizer 11 is to keep the normal voltage of the grid at a steady value with respect to the filament and eliminate the hum of the alternating current supply while the negative voltage from battery 12 holds the grid at its best potential for amplifying purposes."

Further down, line 15:

"The secondary of audio frequency transformer 6 is connected to the grid of tube 7 and to stabilizer 11, with series grid battery 12, functioning the same as in the first stage."

Continuing on after that last sentence:

"In the output or plate circuit of tube 7 the primary of the telephone transformer 8 is connected, which has a one to one ratio of winding. This transformer also serves to reduce the hum of the alternating current supply."

Further down on the page, line 40, on page 2:

"Winding 21 supplies high voltage for the plates of the amplifier tubes 5 and 7, said high voltage being rectified by tube 18 and smoothed out by condenser 16 which is about 4 microfarads capacity, and a choke coil 17.

This provides a high voltage direct current which is suitable for the plates of the amplifying tubes."

Line 56, on page 2 states:

"The filament of this tube is lighted from winding 25 of transformer 29 and winding 26 supplies the proper voltage which is rectified by tungar tube 14 and applied to the field winding 10."

Now, on the same page, line 61:

"In spite of the fact that the sole source of power for this circuit is from the 60 cycle alternating current source, there is practically no resultant hum in the loud speaking telephone due to the reactance offered by the winding 10 and the cooperative effect of this winding with the output circuit of the amplifier system. That is to say the inductance of the field coil 10 is selected of such value and the power amplifier is so connected with the winding 9 that pulsations in the field winding are effectively opposite in phase to the phase of the pulsations in the output circuit of the amplifier so that there is a tendency for the disturbing current to be neutralized as a result of which the armature remains stationary so far as the effects of disturbing current components are concerned."

Then on page 2, line 93:

"In the plate circuit of tube 5, in series with the primary of the audio frequency transformer 6, is a condenser 32 of about .02 microfarads shunted by a resistance of approximately 80,000 ohms. This condenser serves to partially block the 60 cycle hum, but allows the higher frequencies to pass through. The shunt resistance allows the direct current plate voltage to reach the plate around the condenser, but serves as a block to the low frequency hum."

"In series with the secondary of the audio frequency transformer 6 in the grid circuit of tube 7 is a .02 microfarad condenser 31 shunted by a 2 megohm resistance. This condenser and leak 31 function the same as condenser and leak 36 in eliminating any low frequency hum."

Lines 110 to 116 as follows:

"A .02 microfarad condenser shunted by an 80,000 ohm resistance 34 is in series with the plate circuit of tube 7 and functions in the same manner as condenser and resistance 32 to eliminate any residual low frequency hum."

"Condenser 35 is about .005 microfarads capacity and is in series with the secondary of the telephone transformer 8. It also serves as a partial block to any low frequency hum which may be present."

Pages 3, lines 10 to 17:

"The sliders of rheostats 11 and 30 are adjusted to an electrical mid-point in the resistance, at which point the voltage impressed on the grid of tubes 5 and 7 from the A.C. supply is steady or of very small value. By this adjustment the hum is eliminated from the reproducer circuits. * * *

"It will be understood that we are not limited to the use of a reproducer employing a field winding but that any type of reproducer may be employed."

This latter statement indicates that hum is eliminated not as a compensation device described before with the armature and field reacting with each other.

Page 3, line 24:

"The disturbing pulsations which may be present in the winding 9 are of opposite phase by virtue of the phase shifting circuit 8-9, than the phase of disturbing pulsations or currents in the winding 10. The mutual effect therefore is nil as the pulsations tend to be neutralized and have no effect upon the armature."

I think that covers in substance the methods of hum elimination.

XQ506. If I correctly understood your answer, the only instructions which the patent contains as to how to connect a loud speaker of the electrodynamic type to an amplifier are as follows: First, the instruction contained at lines 69 to 80 on page 2, regarding so selecting value—of the inductance of the field coil, and so connecting the power amplifier with the winding 9, which is the armature coil, that pulsations in the field winding are effectively opposite in phase to the phase of the pulsations in the output circuit. Secondly, a method which consists

in making an amplifier which does not hum and connecting it to any loudspeaker which does not hum; is that correct?

Mr. Edwards: I object to that. The patent speaks for itself. I think we, as layman, can read the patent on that subject. I think that is outside of the direct examination, and it seems to be taking the time of the Court unnecessarily to go over the patent specification with this witness.

The Court: What have you to say, Mr. Barus? Wherein does it come in on cross-examination?

Mr. Barus: The witness has testified concerning the use of this patent in the defendant's loudspeaker 104. He has further testified that a specific method of connecting and selecting a field coil magnet is not used to any appreciable extent in our loudspeaker, if I have correctly understood his testimony.

Mr. Edwards: But he did not testify as to whether any particular part of the apparatus was disclosed in any part of the specification. The testimony was general as to the device shown in the drawings and generally referred to in the patent.

The Court: Do you press your question, Mr. Barus?

Mr. Barus: I withdraw the question, I guess I am under this difficulty, that except for some construction of the claim, I can not understand anything how we can infringe.

The Court: I understand that.

Mr. Barus: And I do not understand how the witness has alleged or described anything in our patent which leads to his conclusion.

The Court: I have assumed that to be your position.

Mr. Barus: I do not know of the case we have to meet and I would like to find out. I confess I do not know how to do it in view of the fact——

Mr. Edwards: This witness was not called as a lawyer to testify as to the argumentative infringement of the patent. That, as counsel, we reserve to ourselves.

GLENN W. CARPENTER, a witness called by the defendant.

DIRECT EXAMINATION

Resident of Schenectady, New York, employed by the General Electric Company as radio engineer in charge of development and design of broadcast receivers. From February, 1918 until March, 1921 he was radio engineer at the Washington Navy Yard, Washington, D. C. In March, 1921 until June, 1922 he was engineer in charge of the development and design of commercial receivers for the Federal Telegraph Company of Palo Alto, California. From June, 1922 until November of that year he was in business for himself manufacturing audio frequency transformers and a small receiver. He entered the employ of the General Electric Company on November 1, 1922. During the summer of 1918, while with the Navy Department, he started the development of the first receiver made for the Navy of the type which consisted of untuned radio frequency stages, a detector and audio frequency stages, which receiver was known as the SE-1405. He also designed similar receivers for the Navy known as SE-1605, as well as SE-1617 and SE-1615.

Q42. State whether or not in the manufacture of the 104 the wires which lead from the moving coil and field coil are marked in any way to indicate the manner in which they should be connected to their respective binding posts in the loud speaker amplifier? A. They are not marked and it makes no difference.

Q43. State whether or not you ever gave any instructions to the factory with respect to the manner in which the leads from the armature coil or the field coil should be connected to the binding posts in assembling the 104 loud speaker? A. I gave no instructions to that effect.

Q43a. Does it make any difference which way they are connected? A. No.

Q44. Why not? A. We used a method that eliminates the coupling between the field coil of the loud speaker and the armature of that speaker, and which also steadies the magnetic flux in the area and therefore the speaker is an independent part of the system.

Q45. And by the speaker you mean the pot magnet of the moving coil as distinguished from the power amplifier device which has been referred to as the 104 loud speaker? A. Yes.

Q46. What arrangement or means do you employ for this purpose? A. We use what is commonly called a

copper shading coil and this shading coil is located between—that is nothing but a large copper disc and it is not a winding—and it is located between the field coil and the armature coil.

Q47. What is the effect of that large copper disc? A. It eliminates the coupling between the field coil and the armature coil, thereby making it impossible to transfer the power from one coil to the other and steadies the magnetic flux in that area.

Q48. Have you ever operated the 104 speaker with these copper shading coils removed, and if so, what was the result? A. I have done that and the hum is very much greater without the shading coil, the hum produced in that loud speaker.

Q49. And by the loud speaker do you refer to the speaker in the limited sense of the pot magnet in the armature or in the broad sense of the whole device? A. In the limited sense, that is, as a pot magnet; in the limited sense speaking of the field coil and the armature coil.

Q50. Have these copper rings any effect upon the operation of the amplifier device in the 104 loud speaker as distinguished from the operation of the pot magnet? A. None.

Q51. State whether or not you have operated the 104 loud speaker with the field magnet removed from the filter system and equivalent inductance substituted for it so as not to change the filtering effect, and did then separately energize the field magnet at some distant point with commutated current from a D.C. generator and supplied the moving coil with signal from the amplifier? A. Yes.

Q52. And if so, did that make any appreciable difference in the hum produced in the loud speaker? A. Yes, I have done that and it makes no appreciable difference in the hum produced in the loud speaker.

Q53. For what purpose did you do that? A. That becomes necessary when you are required to operate a relatively large number of loud speakers all from the same amplifier, that is, the field takes so much energy when you use more than one or two, that it is necessary to supply the field with a separate power source.

Q54. And is that something that you have had occasion to do frequently? A. Yes.

Q55. That is done for work in auditoriums and the like where you wish to have a large number of loud speakers about the place? A. Yes.

FRANK WATERMAN, (a patent expert) produced by the defendant.

DIRECT EXAMINATION.

Q198. Please explain the disclosure of the Dunmore and Lowell patent in suit No. 1,606,212. A. The Dunmore and Lowell patent No. 1,606,212 shows an audio-frequency amplifier whose filament and plate voltages are supplied from alternating current and associated with a speaker of the so-called electrodynamic type originally described as a Magnavox speaker.

In Fig. 1 the grid biasing voltages of the tubes 5 and 7 are obtained from a battery 12, the grid return being to a slidable connection upon a potentiometer 11 connected in shunt to the filament supply mains. The filaments are lighted from a transformer 20 through a rheostat 15 and are connected in parallel.

The plate voltage is supplied from a secondary 21. It passes through a half wave rectifier tube 18 and thence through a coil 17, which is entirely without function, through the bottom wire and up to the top of the diagram where it passes through the primary of the transformer 8 to the plate of tube 7 and through the primary of transformer 6 to the plate of tube 5, the return being to one side of the filament where the condenser 16 is connected and also the right hand end of the secondary 21.

There is thus a half wave rectifier with a condenser 16 connected across it and a choke coil 17 connected in series between the tube and the condenser tap.

Since this is a half wave rectifier that choke coil 17 is functionless. In other words, as soon as a wave in one direction has passed the tube becomes open circuit and it is impossible for a choke to do anything in the way of prolonging the smoothing out of the current when it is so located.

In other words, a half wave rectifier does not permit of such a device. It is on the wrong side of the condenser 16.

There is, therefore, only the filter condenser 16 for converting the intermittent half waves of alternating electro-motive force into anything approximating a continuous current voltage.

The loud speaker or Magnavox 9-10 is shown as having its moving coil 9 associated with a transformer 8, the primary of which is in the output circuit of the tube 7. The signals received are therefore arranged to give rise to current in the coil 9. Also all hum introduced by virtue of the inadequate filtering of the plate supply and all hum introduced by virtue of the character of the filaments, their fluctuating temperature, their magnetic field, their electrostatic field, are similarly introduced into the coil 9.

The compensating or cure method is attempted as in the Lowell and Dunmore patent where I have fully discussed this, that is to say, the plate return is to one leg of the filament, thereby voltages are introduced in the plate circuit of an alternating current nature corresponding to the voltage across the filament.

To compensate for this a voltage is introduced into the grid circuit by approximate adjustment of the slider on the potentiometer 11. Whatever may be the ultimate effect of this, any remaining currents are transferred to the moving coil 9 of the loud speaker. The magnet 10 of the Magnavox is excited from a secondary 26 through a rectifying tube 14, the filament is lighted by secondary 25. No attempt is made to smooth out this current. It is a well known fact that a magnet and also the Magnavox in particular had the capacity for smoothing out any amount of ripple by its own inductance; but this is not just a certain kind of ripple. This is full current part of the time, and no current rises all the time; and furthermore, it is in connection with the half wave rectifier, which has resistance half the time. It results that in the magnet 10 there are pulsations and in the coil 9 there are pulsations; and the specifications as issued have two passages inserted during the prosecution of the case, as I find from the file wrapper, one beginning with the word "due" in line 63 of page 2, and extending over to line 80 of the same page, and another beginning with the words "the disturbing," in line 24 of page 3, and extending to line 32, which passages state

that the disturbing pulsations or the pulsations which would be disturbing in a telephone or a speaker of the magnetic type, are cancelled out by so relating the phase and magnitude of the pulsations in magnet 10 to the pulsations in the coil 9, that the coil 9 does not move in the field in response to such pulsations. There is no description as to how that is done. It is merely said that the inductance of the field coil 10 is selected of such value and the power amplifier is so connected with the winding 9 that pulsations in the field winding are effectively opposite in phase to the pulsations in the output circuit of the amplifier. How that can be brought about I do not know and the patent does not enlighten one.

The electrical relations involved are these—and in speaking of them it is necessary to have in mind the structure of the speaker, and the patent originally did not contain a reference to electrodynamic speakers, it referred to the Magnavox feature, a construction well known——

Mr. Edwards: I object to that. This witness has no knowledge of that. It is a matter of record, and I ask that be stricken out.

The Court: I think the motion is properly made and is granted.

Mr. Barus: May I state, your Honor, that the file history does show that as originally filed, the application referred to the Magnavox speaker, and that on objection of the Patent Office the trade name "electrodynamic" was inserted, and "Magnavox" deleted.

The Court: You have reference to that?

Mr. Barus: I was calling that to your Honor's attention in connection with the witness's testimony.

The Witness (continuing): "In order to give any interpretation to the language of the patent, it is necessary to have in mind a structure, and in explaining therefore what the patentees probably meant, I will have in mind the construction of a once well-known electrodynamic speaker known by the trade name "Magnavox", the construction of which I am familiar with."

In a speaker whose moving coil is inductively related to the field magnet in which the coil is to move, as is the

case in the Magnavox speaker, pulsations in the magnet 10 of the Dunmore and Lowell patent would set up in the closed circuit constituted by the coil 9, and the secondary transformer 8, electro motive forces due to changing magnetic flux produced by the magnet 10. By themselves, those alternating electro-motive forces would cause currents to flow in the secondary of the transformer 8 and the coil 9; but they are already alternating currents presumed by the specification by the secondary of the transformer 8 and in the coil 9 which have come from the amplifier system.

Now, what the patentee proposes is that advantage should be taken of this inductive relation, and that the electro-motive forces which are induced by the pulsations in the magnet 10, should be exactly opposite in phase to those which are brought into the coil 9 from the amplifier, and if they were of opposite phase and also equal in magnitude, they would cancel out and that is the thing which the patentee proposes in the two passages on pages 2 and 3 respectively, to which I have called attention.

In Figure 2 of the Dunmore patent, a similar arrangement is shown. That is, there are two tubes with alternating current supply for their filaments, and for the plate voltage, and for the magnet of the electrodynamic speaker. You get the same letters of reference so that what I have said may be applied to either figure, except as to the method of biasing the grids of the two tubes, and as to certain other additional features which I will mention. The grid of the tube 5 is balanced as in the radio stages of Figure 1 of the Lowell and Dunmore patent, namely, by a grid leak and condenser combination 36, inserted in the grid return, and the latter goes to a shiftable point of potentiometer 30, connected across the filament supply wires. The grid of tube 7 similarly comes through a grid leak and condenser combination 31 to a shiftable connection on the potentiometer 11, also across the filament supply leads. There is therefore used here the grid condenser method of biasing which requires the flow of grid current in order to effect the bias.

In order to minimize the alternating currents introduced through the return of the plate circuit to one side

of the filament, this being exactly as I have already described in connection with Fig. 1—and the imperfect filtering of the plate supply, other instrumentals are introduced, such as the condenser and leak combination 32 and 34, found respectively in the primaries of the transformers 6 and 8.

My experience with arrangements of this kind indicate that they are simply amplification killers, that reduce hum only because they reduce everything else.

In the output circuit of the amplifier containing the coil 9, there is placed a condenser 35, the value for which is given in the specification at page 2, line 117, as about 0.005 microfarads. Unless I am mistaken in the figures which I have hastily made here, this condenser, while probably effective to keep 60 cycles out, would keep everything else out too, except the high frequencies; that is, it would be a condenser of enormous impedance to the signal alternating currents. Its impedance to 60 cycle alternating currents would be in the order of half a million ohms. Now may I have the question again.

Q199. The question was simply explain the function of the device of the Dunmore and Lowell patent. A. The foregoing I think is a correct general outline of the disclosure.

Q200. This condenser 35 to which you have just referred, how does that compare with the condenser 34 in the Lowell and Dunmore patent in suit, Fig. 2, and with the condensers of the V. H. Brown article in evidence, concerning which you have already testified, as corresponding to 34? A. It is the same as the condenser 24 of the Lowell and Dunmore patent No. 1,455,141, except that the magnitude of the latter is four times as great. It is the same in function as the condensers marked C.C. in the V. H. Brown article, Exhibit 35, and is for the same purpose as pointed out in that article.

Q201. Please refer briefly to the article entitled "Church Sermon heard half a mile" in the Electrical Experimentor of November 19, 1919, page 636, 684, 686 and 688 and explain the relation of that article to the Dunmore and Lowell patent No. 1,606,212.

Mr. Barus: I offer this article now in evidence.

(Received in evidence and marked "Defendant's Exhibit No. 77.")

A. This article refers to an electrodynamic speaker which it says is "known as the Magnavox". I recognize the construction shown in the diagrams on page 684 as illustrating the construction of a speaker known as the Magnavox, with which I was familiar at one time.

Referring for a moment to the figure on page 684, the magnets appear as the two black vertical columns, one of which is designated by the words "field magnetizing coil". The pole pieces are at the top, and there is a small space between them into which there descends a black body which in fact is half of the moving coil, the other half being bunched into a more or less circular form above it, and connected to the moving diaphragm of the speaker.

The field magnet corresponds to the part marked 10 in the Dunmore and Lowell patent, while the coil part of which is between the poles of the field magnet, which corresponds to the coil marked 9 in the Dunmore and Lowell patent.

The article describes the use of this speaker in certain tests, and describes the speaker as

"Electrodynamic" and says "The diaphragm is not acted upon directly by the magnetic flux from the electro magnet. Instead a minute insulated wire coil is placed in a small air gap about 1/16 inch long between the pole pieces of the powerful electro-magnet which pole pieces are magnetized north and south shown in the accompanying drawing."

It goes on to say that permanent magnets are not employed but that the field magnets are energized by currents which are applied to a coil wound upon them. The statement is made that the magnetizing coils consume only a small amount of current, or about 25 watts, and that the Magnavox speakers are supplied to operate on 6 or 8 or 12 volts direct current from the battery as desired, or on a 110 volts D.C., and it then states:

"That contrary to the general opinion no noticeable effect is caused in these reproducers when the latter current is used (that is 110 direct current from the house

lighting main). Due to the commutator ripple, as owing to the high impedance of the windings, the pulsations characterizing such direct current supply are smoothed out.

"The audio currents carried by such direct current supply means are in the nature of ripples superimposed upon a current which otherwise would be of the nature of the battery current, and the statement means that the high self-inductance of the magnets is sufficient to prevent fluctuations of the Magnavox magnetism, even though the current supply does not fluctuate."

Q202. Please refer to the patent to Pridham & Jensen, No. 1,105,924, and explain the differences there described in its relation to the Dunmore and Lowell patent?

Mr. Barus: The defendant offers in evidence the Pridham & Jensen patent.

(Received in evidence and marked "Defendant's Exhibit No. 78.")

A. The Pridham & Jensen Patent No. 1,105,924 relates to a dynamic speaker in which there is a field magnet excited by a current flowing through a winding and a moving coil suspended so as to be subject to the field and hence capable of motion when the coil is supplied by voice currents.

I will refer to Fig. 3, which is the figure in the lower righthand part of the drawing. The field magnet winding is indicated at 9 and the air gap is of annular form, being in the form of a narrow circular slot between an inner pole piece of annular shape and an outer pole piece of ring shape.

Coil 2 is connected mechanically to a diaphragm 11 and mounted so as to be within the field.

The patent explains that when currents having superimposed thereon ripples or alternating current voltages are employed for the field magnet, the fluctuations induce currents in the telephonic coil which, reacting upon the normal or average field strength of the magnet, produce vibrations which greatly interfere with the action of the instrument.

Those are induced voltages, induced in the manner in which I have explained in considering the Lowell and Dunmore patent, fluctuations in the magnetism of the field. Threading the moving coil set up therein electro-motive forces which are closed through the circuit supplying that coil and therefore produce hum in the sound coming from the speaker.

To prevent this the patentee connects in series with that coil 2 a coil 3, which is also threaded by similarly pulsated mechanism supplied by a coil 10 which in turn carries the same current as the coil 9 exciting the field magnet.

Here is a case permitting of definite proportioning, so that electro-motive forces may be introduced into the coil 2, which are equal and opposite to the electro-motive forces created in the coil 2 by the pulsations of field strength resulting from a variable current in the magnet coil 9.

This method of compensation or neutralization which is proposed in the Lowell and Dunmore patent, namely, to reduce in the circuit of the moving coil electro-motive forces equal and opposite to disturbing electro-motive forces existing there, is disclosed in this Pridham & Jensen patent.

Q203. Please explain the construction and operation of the 104 loud speaker with particular reference to its magnet and armature coil. A. The 104 loud speaker comprises in essence a large field magnet arranged to produce a very intense radio annular magnetic field. In this narrow annular slot, across which the magnetism extends, there is placed a light paper cylinder upon which an output coil carrying the output from the 210 tube of the power plant of the speaker is wound, and to this small cylinder a paper cone is attached, the vibration of which gives rise to the sounds carried by the received broadcasting and intended to be reproduced.

It is a speaker, therefore, of the electrodynamic type. In fundamental arrangement it differs from the electro-dynamic speaker to which I have just been referring in that the coil in the air gap is in essentially a static or non-ductive relation to the field.

I think I will have to make a sketch in order to explain that idea.

Q204. Mr. Waterman, at the close of yesterday's session, you were describing the 104 loudspeaker, with particular reference to the slot magnet and the armature field coil and relations between them. Will you please proceed with that answer. A. I have made a rough sketch which illustrates the relation which I was about to describe at the close of last evening. The magnet of the 104 speaker comprises a circular shell with a central cylindrical core. This is reduced in size at its end and passes through a hole in the shell. In this fragmentary sketch which I have produced, I show the extreme end part of the shell in section, marked M1, and the cylindrical core marked M2. In the annular space between the tubes, there is a coil of very fine wire which I have indicated by a few circles and marked C. The magnetism passing—I will assume from the central core M2 radially outward to the annular end M1 of the shell, passes parallel to the plane of the coil. It is therefore as nearly as possible in a non-inductive relation with respect to the field; it being well known that a coil laid parallel to the lines of force of a fluctuating field does not have electro-motive forces generated in it. By carefully positioning this coil, this condition of astatic of non-inductive relations may be very closely realized. This means that if the relation were perfectly realized, the pulsations in the field would have no effect in the way of generation of electro-motive forces in the coil; and the effect that is referred to in the Dunmore and Lowell patent could not be produced. It is a fact that the 104 speaker is entirely indifferent to the direction of connection of the coil, either of the moving part or of the field magnet. The effect upon the cancelling out program of the Lowell and Dunmore patent is based, depends upon a particular relation of connections; that is, if with one set of connections the action described in the patent is realized, so that there is no motion as the result of the pulsations of current, either in the field magnet or in the moving coil, and either one of those coils has its terminals reversed, then the electro-motive forces which formerly cancelled it, will give rise to currents exaggerating the effect.

So that a test to determine whether or not the effect of the patent is present consists in reversing the terminals. Reversing the terminals of either the field magnet or the moving coil in the 104 speaker has no effect whatever upon the hum produced. I understand that there is no controversy about that point and so I will not dwell upon it at length.

In the sketch which I have made I have indicated the lines of force by dotted arrows extending radially outward upon the center and parallel to the plane of the winding of the moving coil.

On the test proposed by the patent, therefore, this coil of the 104 speaker is not so constructed or positioned as to realize the effect upon which the cancelling out of hum components can be realized.

The magnet of the 104 speaker, as shown in my schematic diagram, loud speaker model 104, contains within the shell and surrounding the cylindrical core, when it receives the wave from the opening in the end, a magnetizing coil which occupies only a portion of the space. Adjacent to this magnetizing coil at the right thereof as seen in this diagram, there are three heavy copper rings which are seated upon turned shoulders making a very tight fit and also fitting tightly within the shell. The one immediately adjacent to the winding fits tightly within the main shell. The next one is smaller in diameter and fits in a recess in the righthand end member of the shell and the third one is still smaller in thickness, but of the same diameter and fits in the same recess.

These are very massive and constitute a complete shield from the effect of any pulsation or fluctuation of current in the field magnet.

So that the coil which carries the output of the amplifier and the signal currents is completely shielded by this massive copper set of shading coils or copper rings. This is a well known method of protecting one coil from the influence of the other and it results that the coil of the loud speaker which does the moving is completely shielded from effects due to currents in the magnetizing coil of the speaker.

The moving coil, therefore, is first so situated as to be indifferent to fluctuations and next completely shields

it from such fluctuation with the result that there is neither possibility of neutralizing effect or need of it.

The coil is used as the inductance of the Hull filter and with a very large magnet it constitutes a very large inductance. It is preceded in the filter combination of course by the first condenser which I have marked C-1 on my diagram, which is not a small condenser as has been intimated, but it is either a 7-microfarad condenser or a 4-microfarad condenser, different sizes having been used in different instruments, and it is therefore the largest or next to the largest condenser in the whole device.

Its effect upon the current produced by the full wave rectifier is to largely shunt out the alternating current components leaving a current with a relatively small ripple to pass through the coil of the speaker magnet.

Being a full wave rectifier and being thus deprived of the greater part of the ripple the magnet acts in the manner that is well known as the action of magnets in general and the Magnavox magnet in particular, to smooth out ripples and any ripple which gets through this magnet is shunted out by the large condenser C-2.

So that ultimately there is essentially pure direct current flowing to the volt picker. From the volt picker the voltage for the plate supply and current for that circuit is taken from a point 1 through the UX-210 amplifying tube and back to the volt picker. So that there is appreciably no alternating current in the output of the 210 amplifying tube which through the transformer 2 is put through the moving coil of the speaker.

Q205. Will you please compare the 104 loud speaker with the device of the Dunmore and Lowell patent in suit? A. A fundamental difference is the employment in the 104 speaker of a full wave rectifier as distinguished from a half wave rectifier. If I have understood the record correctly the magnet L of the loud speaker in my schematic diagram has been compared to the inductance coil——

Mr. Edwards: I object to Mr. Waterman attempting to construe the record and tell us what people have been comparing things with.

The Court: Objection sustained.

A. (Continued.) The field speaker magnet L of my schematic diagram illustrating the loud speaker model 104 has no analogy whatever to the choke coil 17 of the Dunmore and Lowell patent. That coil in the patent is functionless and its sole effect is to greatly reduce the efficiency of the rectifier. It is not a part of the filter organization.

The magnet of the 104 speaker is a part of a filter organization. It is supplied with current which is to a very large extent pure direct current because of the full wave filter and of the abstraction from the current delivered by that filter of most of its ripple by the condenser C-1.

This speaker magnet L is made in the organization to serve a double function. It acts as the inductance of a filter and at the same time is a magnet for the loud speaker.

In the Lowell and Dunmore patent the magnet 10 of the loud speaker is supplied through a half wave rectifier with no condenser or other smoothing means. The current necessarily, therefore, is to a large extent a pulsating and not a direct current. There is therefore a large amount of pulsation and the patentees contemplate the existence in the circuit comprising secondary of transformer 8 and the moving coil 9 so large an element of alternating current that the large amount in the magnet 10 shall be offset in its effects upon the coil 9 by the hum current coming through the amplifier. Such a condition does not exist in the 104 speaker. The method of prevention and not the method of cure is used in the 104 speaker. The current in the field magnet is to a large extent smooth. The field magnet is so located as to its function, largely as a smoothing means in accordance with the prior art which I have discussed, and the output or rather the plate voltage to the 210 amplifying tube which supplies the signal to the speaker, is so completely filtered and is produced by a full wave rectifier, so that it can be completely filtered, that it results that there is no perceptible alternating current ripple in the moving coil. There is no cooperation between the fixed magnetizing coil and the moving coil to produce therein any of

the cancelling out or curative effects which the patent relies upon, and as a matter of test the proof is complete when, by reversing the inter-coil——

Mr. Edwards: I object to that.

The Court: Sustained.

Mr. Edwards: I ask that reference be stricken out?

The Court: "The proof is complete" beginning there. The remainder goes out.

The Witness: As a matter of fact, my tests show that the reversal of the winding does not in fact influence the hum produced in the slightest degree. There is a hum if one gets close to it. Reversing the windings does not affect that hum, either in volume or quality.

The second figure of the patent shows resistance condenser combinations 31, 36, for biasing the amplifier tubes and resistance condenser combinations 32, 34 for suppressing hum introduced by the half wave rectifier into the plate circuit. Nothing of the sort is found in the 104 speaker.

Also the Dunmore and Lowell patent returns the plate circuits of the two amplifying tubes to one side of the filament and employs a battery 12 in connection with an adjustable slider on potentiometer 11 to compensate for the hum necessarily introduced by the return of the plate circuit to one side of the filament. No such arrangement is found in the 104 speaker. On the contrary, the prevention method is used. The grid and plate circuits both return to fixed mid tap on the center of the secondary lighting, the single amplifier marked 210 in my diagram, the secondary being marked S1. This is therefore the prevention method and not the cure method of the Dunmore and Lowell patent.

There are not in the 104 speaker as in the Dunmore and Lowell patent, two rectifiers. There is a single rectifier system. The Lowell and Dunmore patent has one rectifying tube 18, whose sole function is to supply the plate circuits. It has a second rectifier system, such as tube 14, whose sole function is to energize the field magnet 10. The 104 speaker has a single full wave rectifier system, and the output of that system does not separately

excite the field magnet but excites it in series; so that the current which passes through the UX-210 tube is first passed through the field magnet. That is an entirely different arrangement, based on an entirely different idea of means from this separate half wave rectifiers of the Dunmore and Lowell patent. The 104 speaker does not have two rectifiers. It has two UX-216 bulbs, of course. That is, merely because the power used is larger than can be safely handled in a single double bulb. It, however, constitutes one single rectifier tube, which is a full wave rectifier tube, and neither in construction or in operation is there any analogy between this full wave rectifier system of 104 and the two one-half wave rectifier systems of the Dunmore and Lowell patent.

Q206. Mr. Waterman, will you put some appropriate legend on the sketch of the 104 field magnet which you made in the course of your answer.

Mr. Barus: The defendant offers in evidence the sketch "Simplified Schematic Diagram Radiola 28 connected to loud speaker 104," which the witness referred to yesterday, and which did not get marked at the time.

(Received in evidence and marked "Defendant's Exhibit No. 79.")

The Witness: I have marked this diagrammatic sketch "104 loud speaker floating coil location."

Mr. Barus: The defendant offers in evidence the sketch which the witness has just referred to.

(Received in evidence and marked "Defendant's Exhibit No. 80.")

Mr. Barus: In the last answer the witness referred a number of times to the Lowell and Dunmore patent, when he obviously meant the Dunmore and Lowell patent. I wonder if that can be corrected?

The Court: That is the loud speaker patent?

Mr. Barus: Have you any objection to that being corrected by the stenographer?

Mr. Edwards: What is that?

The Court: Let the witness add—I have been speaking throughout of the loud speaker patent in suit, whether

I call it the Lowell and Dunmore or the Dunmore and Lowell patent; is that correct, Mr. Waterman?

The Witness: It is correct.

CROSS-EXAMINATION.

XQ522. Will you refer to your Exhibit No. 80, the sketch of the defendant's loud speaker floating coil location. The dotted lines with the arrows in the sketch are intended to indicate the magnetic flux? A. Yes. The principal flux.

XQ523. And this flux path is not complete in your sketch? A. Oh, no; just across the area.

XQ524. The complete path would be through the central magnet core in one end, say the end shown in your sketch there dividing into two paths, one path going to one side, and through the side portion of the magnet, and going back to the other end of the central core M 2, and the other branch having a corresponding path through the other part of the magnet? A. Yes. Except that that is a sectional view of a cylindrical structure so that the magnetic field must be considered as proceeding radially from a central core out in all directions to the surrounding shell.

XQ525. Yes. Now, this sketch does not show the copper ring that has been alluded to? A. No. It does not, except the position of the coil.

XQ526. Would you mind indicating in the sketch the position of that copper ring? A. There are three copper rings and the sketch is not made with such accuracy as to permit that. Their position is quite accurately shown in my diagram, which I have already produced, which is made from measurements though rather small, it may be taken as quite accurate as showing the position of the rings. There are three of them; one which fits the largest diameter to the shell, and also over the largest cylinder of the central core. Then there is another one fitting into a small turn recess and a smaller turn diameter of the coil and there is still another of the same diameter to separate.

XQ527. This diagram of the exhibit of the schematic diagram loudspeaker Model 104 is rather small, and I find it difficult to follow the location of all of these rings. Would you mind making an enlarged sketch which would indicate approximately the position of those rings with respect to the parts which are illustrated in your sketch, Exhibit No. 80? A. I made a sketch which was fragmen-

tary in its nature indicating a sectional view. The dotted cross hatching indicates the section of the outer cylindrical part and the solid cross hatching indicates the three rings.

XQ528. Would you mind lettering the three rings and the parts of the core of the magnet and will you add the position of the coil? A. I have done so.

XQ529. In this sketch the two portions of the magnet core corresponding to this Exhibit 80 are indicated as M-1, M-2 and the three copper rings by R-1, R-2, R-3 and the position of the coil by the letter C; that is correct, is it not? A. Yes.

XQ530. When the voltage of the current in the coil on the core M-2 changes due to ripple or other cause, that induces current in the rings R-1, R-2, R-3, does it not? A. Yes, any fluctuation of current in the magnetizing guard which is adjacent to and at the left of the rings tend to set up currents in the rings, which on account of the extremely low resistance of the ring prevent changes of magnetism at the right of the ring.

XQ531. Would you indicate on this sketch the position of the coil on the core M-2, indicating how far out towards the end of the core it extends? A. I have not any measurement for that and I have not a very distinct recollection, but I can only indicate in a general way. Of course, it should be understood that the sketch was purely free hand and does not purport to be in dimensions, in any case, but my schematic diagram with respect to the location of the rings is all right as to scale.

XQ532. Exhibit 74 was to scale and Exhibit 80 is not to scale? A. That is correct. I have indicated by double cross hatching the approximate location of the end of the field winding and I designate the winding by the letter F.

XQ533. When there is a change in voltage in the coil C that also causes or tends to cause current to flow in the rings R-1, R-2, R-3, does it not? A. I think not. I do not know. I will answer it in this manner. I think not in any significant sense.

XQ534. Theoretically it should do so, should it not? A. I doubt if even that is true, but I am not sure. The ring nearest to the coil is purposely cut away and I doubt if the copper is subjected to any field due to the floating coil.

XQ535. If the coil were separated entirely from the magnet and were in the open air, then change in voltage in the coil C would create magnetic flux flowing through an air path, would it not? A. Yes.

XQ536. Now assuming that the coil is in its present position there would still be the tendency to create such magnetic field, would there not, by reason of change of voltage in coil C? A. Yes, to be theoretically expressed by a trifling change in the distribution of the flux. I do not think it is enough in a practical sense to define it.

XQ537. Assuming that that change is of sufficient power, then that would cause current to flow in the rings R-1, R-2, R-3, would it not? A. No, I do not think so.

XQ538. Upon what do you base your belief that the change in voltage of coil C would not cause current to flow in the rings R-1, R-2, R-3? A. The rings are so located and protected from the coil C that I am unable to see how there would be any cutting of the ring by flux produced by the excessively small currents in the coil.

XQ539. Does not that come to asserting that the energy of the fluctuations in the coil C is not great enough to cause a measurable current to flow in the rings R-1, R-2, R-3? A. I am not sure about the connection between the premise and the conclusion. I think the conclusion is correct.

XQ540. Is not the conclusion based upon the assumption that the energy of the fluctuation is not great enough to cause a measurable change? A. In comparison with the available magnetic path that might be a correct way of stating the position, in other words, the path provided for any magnetism produced is so enormous in section as compared to any fluctuating magnetism that could conceivably be created that it is a necessary assumption that there may not be any detectable intensity of field from any fluctuations in the coil, particularly since every precaution is taken to prevent such fluctuation.

Mr. Edwards: I will ask to have the sketch referred to marked for identification.

(The said sketch was marked "Plaintiff's Exhibit CC for Identification.")

CECIL E. BRIGHAM, a witness produced by plaintiffs, began his experience in radio engineering in 1917 when he joined the United States Naval Reserves where

he acquired radio instruction in full and experience in radio testing. In 1919 he became engaged in radio testing, research development at the Radio Testing Laboratory, Washington, D. C. From 1919 to 1921 his work consisted of testing all kinds of radio receivers and amplifiers. Between 1921 and 1922 he was in the Research and Development Department at the Radio Testing Laboratory. In 1922 he became associated with the Brandes Company of New York City, known as C. Brandes, Inc. of 237 Lafayette Street, New York City (now known as the Kolster Company). He was engaged with them in the direction of research and development of acoustical devices and had directed that work for four years. For the two years last past he was head of the Laboratory and all branches of radio research development, the governing acoustical devices, radio receiving devices, amplifying devices, and the then present electric sets. He is familiar with alternating current operated receiving sets of different makes.

DIRECT EXAMINATION.

Q49. How long have you known of the electrodynamic type of loud speaker? A. For about six years.

Q50. Were they on the market when you first heard of them? A. My first experience with the dynamic type of speaker was with a commercial product known as the Magnavox D.C. dynamic speaker. That speaker employed six volts, two or three amperes for the field excitation.

Q51. What success was enjoyed by that speaker at that time commercially to your knowledge? A. The principle of that commercial speaker was very good, but due to the fact that the field excitation necessary had to be obtained from a six-volt storage battery, the drain on the storage battery just for the field excitation was actually sometimes more than the drain from a radio set and consequently that speaker was not popular because it wore down or drained down the battery too rapidly and the public would not continue to have that bother and so the first dynamic speaker at that time was not popular.

Q52. Why do you say the principle was good? A. The electrical principle of a moving coil system in a strong magnetic field, which field was obtained by a separate source of field excitation.

Q53. Were there any advantages in that type of speaker over the permanent magnet type? A. Yes,

there is a great advantage for the reason that in magnetic or permanent types of speakers you are limited to the amplitude of vibration of your moving element. In a dynamic type of speaker you are not limited to the amplitude of vibration of your moving element and consequently since bass notes or low frequencies response depends upon the amplitude of the vibration of the moving element the dynamic principle is very important.

Q54. Is the dynamic type of speaker popular today? A. Very popular.

Q55. To what would you attribute its present popularity as contrasted to its unpopularity in 1922? A. Strictly in the means that it employed to obtain the field excitation for this dynamic speaker.

Q56. Will you explain that last answer a little more in detail? A. The field is excited by means of a rectified alternating current and since a rectified alternating current can be obtained readily there is no trouble or annoyance to the customer by using such means for a dynamic speaker.

Q57. Do you mean annoyance in regard to power? A. Annoyance as far as trouble in seeing that you always have the correct excitation for your field.

Q58. That removes the objections which were previously existing with battery power, is that correct? A. Absolutely.

Q59. Are you familiar with the Radio Corporation loud speaker 104? A. I am.

Q60. I hand you Defendant's Exhibit 74 and ask you if you know of the presence in the actual speaker of copper rings such as shown at the righthand portion of the top element in this exhibit? A. By looking at the drawing there is no specific mention of copper rings, but in my own experience and the investigation of the 104, I know there are copper rings existing at that unit.

Q61. Will you explain just how these rings act in the operation of the speaker? A. It has always been my belief that the copper rings serve two purposes, one is for the reduction of hum from the loud speaker device, I mean by that that there is a certain ripple voltage in your field winding and the copper rings by means of the Eddy currents introduced by the ripple voltage from the field does help to reduce the hum ripple or the voltage induced in the voice coil.

The other purpose of the copper ring is the effect that it has upon the high frequency response from the loud speaker. The copper rings being in proximity to the voice coil it changes the characteristic of the voice coil at high frequency to effect the high frequency response.

Q62. Will you explain more in detail just how those rings act to reduce fluctuations? A. The copper ring being above the field coil it has the effect of a short-circuited turn, a large short-circuited turn and any ripple that is in the field winding will induce voltage in the copper ring and Eddy currents existing, and there is 180 degrees phase relation from the Eddy current nullifying the ripple from the field coil.

Q62. Is this ring similar in its action in a short-circuited transformer secondary winding? A. It is exactly analogous to a short-circuited single turn secondary of a transformer.

Q64. Of what use is it if any to have an amplifier tube used in connection with an electrodynamic loud speaker? A. An amplifying tube must be employed with any type of speaker to get a satisfactory acoustic response.

Q65. And just why is that? A. Because the efficiency of speakers in general means that the audio-frequency rectified by the detector must be amplified to a satisfactory point such that it will get satisfactory acoustic output.

CROSS-EXAMINATION.

XQ118. What acoustical devices was the C. Brandes Company then making? A. Devices known as telephone receivers or telephone head sets.

XQ119. Were they making any loud speakers at that time? A. Not when I first joined the company.

XQ120. So that at that time your work was exclusively with telephone receivers and head sets. A. That is right.

XQ121. When did you first have any experience with loud speakers while you were with the Federal Brandes Company? A. As early as January and February of 1923.

XQ122. January or February, 1923? A. That is right.

XQ123. Prior to that time had you tested any loud speakers? A. No.

XQ124. What was the first loud speaker that you tested? A. I believe the first commercial speaker that I had any experience with was the Western Electric horn type speaker. I cannot recall the type number of that speaker. Then others followed the Western Electric type speaker.

XQ125. Is that the cone type speaker or horn type speaker? A. Horn type speaker. Then our own development of horn type speakers.

XQ126. Before you began your development had the Western Electric cone type speaker come out? A. It had not.

XQ127. And when did you begin your development at the Federal Brandes Company? A. About May or June of 1923.

XQ128. And what type of speaker did you then put on the market? A. The horn type speaker.

XQ129. Was it an electrodynamic horn type or a permanent magnet type? A. A permanent magnet type.

XQ130. And how long did that particular type which you first put out continue on the market? A. It continued during 1923, 1924 and even in the early part of 1925.

XQ131. What was the next type of loud speaker that the Federal Brandes Company put out? A. The cone type of speaker.

XQ132. And what is a cone type speaker? A. A cone type speaker is one in which the moving membrane to get out the acoustic response is made up out of some material in shape of a cone, that cone actuated by some unit device.

XQ133. And when did you put out that cone type speaker? A. I believe it was in the early part of 1925.

XQ134. At that time what was the state of the market, if you know, with respect to cone type speakers as compared with the diaphragm type of speaker which was first put out? A. Do you mean diaphragm type of speaker, the horn type of speaker?

XQ135. Yes, the horn type. A. During the time when we first put out our cone type of speaker the market was about fifty-fifty as far as cone type versus diaphragm or horn type of speaker.

XQ136. And the horn type was a diaphragm type, was it not? A. That is a matter of opinion whether you call a horn a diaphragm type of speaker or not. You could call a cone a diaphragm type of speaker.

XQ137. What was the moving part in that horn type of speaker? A. A diaphragm.

XQ138. What is the state of the market today with respect to horn type speakers having a diaphragm and cone type speakers? A. I think it is known to every one that the cone type speaker holds the majority of the market.

XQ139. Very much the majority? A. Very much.

XQ140. When did you first become familiar with the Magnavox loud speaker? A. Sometime in 1923.

XQ141. What kind of a speaker was that at the time you became familiar with it with respect to cone or diaphragm? A. It was a diaphragm or horn type of speaker.

XQ142. Had you ever had any experience with the Magnavox Loudspeaker before that time? A. No.

XQ143. And how long did you continue to have experience with the Magnavox loudspeaker after that time? A. The Magnavox loudspeaker was purchased just to obtain information of that type of speaker and the experience gained immediately after the purchase of the speaker was sufficient to realize the limitations of that speaker.

XQ144. What were the limitations of that speaker that you mention? A. The method employed in the field excitation of the speaker.

XQ145. Now, did not the Magnavox Company also make a type of Magnavox speaker in which the field coil was excited by direct current from a generator? A. When you say a generator, do you mean a D.C. generator?

XQ146. Yes. A. Yes. I believe they did put out a dynamic type of unit which could be used on 110 volt D.C. supply source.

XQ147. It was well known prior to that time, was it not, how they rectify alternating current so as to produce direct current? A. Yes, it was.

XQ148. Would there have been any difficulty in providing a rectifying outfit for rectifying alternating current for the field of the Magnavox loudspeaker? A. I would have to answer that, knowing the art as I do today, that the tubes at that time were not power rectifying tubes, as we used 3-element tube as a rectifier, and in those days you could get rectification, but could not get

sufficient power rectification to give you satisfactory field excitation for a dynamic speaker.

XQ149. That is, the trouble was with the absence of suitable rectifying tubes? A. That is right.

XQ150. If the rectifying tubes had been available, there would have been no trouble, would there; in applying rectified and filtered alternating current to the field coil of the Magnavox loudspeaker?

Mr. Neal: That I object to. It is not limited as to whether it is present knowledge or what is known up to that time, and it seems to me rather indefinite.

The Court: Present knowledge.

Mr. Barus: It is the same knowledge from which he spoke from in his direct examination, whatever it was, as to that very subject.

The Court: I think you may answer.

A. There was not.

XQ151. With the Federal Brandes Company putting out its first type of cone loudspeaker, was it an electro-dynamic loudspeaker or a permanent magnet loudspeaker? A. It was a permanent magnet loudspeaker.

XQ152. And why was that? A. The reason for the permanent magnet loudspeaker was that it was a more efficient speaker at that time to be used with the circuits that were designed commercially.

XQ153. And it was cheaper, was it not? A. Very much cheaper.

XQ154. When did the Federal Brandes Company put out an electro-dynamic type of loudspeaker, if at all? A. During the latter part of 1926 or the first part of 1927.

XQ155. Was that a cone type speaker or a horn diaphragm type of speaker? A. A cone type speaker.

XQ156. Referring to this Plaintiffs' Exhibit No. 48, I notice that in the back of the cabinet, there is a device bearing the label "Brandes table talker". What is the Brandes table talker? A. The Brandes table talker was the first diaphragm or horn type of speaker which the Brandes Company put out in the latter part of 1923.

XQ157. And at what date was that put out? A. In the latter part of 1923.

XQ158. Was it the electro-dynamic type of the permanent magnet type? A. A permanent magnet type.

RDQ336. When did you first see an alternating current operated electrodynamic loud speaker? A. I heard about it before I actually saw one. Your question is a rectified energy of a field coil on a dynamic speaker?

RDQ337. When you first saw a loud speaker having alternating current power applied in that way? A. I was answering as far as actually seeing the device, the RCA 104 was the first device of that kind that I had seen, but I knew of such a device from the second Lowell and Dunmore patent.

Mr. Barus: I object to that.

Mr. Neal: I do not care whether that goes in or out. I would just as soon have the last part stricken out.

The Court: Then it is stricken out.

ALEXANDER NYMAN, called by the plaintiffs. Resided at Hartsdale, New York, and was Manager of Radio Patents Corporation. His first experience in the radio art was during his college work during 1914-1916 at Manchester College of Technology, Manchester, England, where he investigated the possibility of submarine signalling. In 1917 he was employed by the Westinghouse Company of East Pittsburgh, Pennsylvania, and was assigned to development work on generators for application to radio to aircraft for the Air Service of the United States. Later, in the same year, he joined the Air Service Radio Section and went through complete training as a radio officer. After the War he was again employed by the Westinghouse Company as assistant to a consulting engineer of that company, a Mr. Conrad, who was at that time engaged to a large extent in the development of radio apparatus. He assisted Mr. Conrad in putting up the appliances in the KDKA station and, subsequently, in 1920 was assigned the work. In 1921-1922 he was at work on the development of loud speakers which were later manufactured by the Westinghouse Company. In 1923 he left the Westinghouse Company and was employed by the Dubilier Condenser Corporation, in charge of the engineering department which conducted research work on condensers used in the radio art and their application to radio receiving and transmitting circuits. In 1926 he left the Dubilier Company and was employed by the Radio Patents Corporation do-

ing consulting work for the Dubilier Condenser Corporation and, as Manager of the Radio Patents Corporation, handled the interchange of technical information and inventions, particularly in the radio art between the Dubilier Company and associated foreign companies.

DIRECT EXAMINATION.

Q36. Will you turn to the Lowell and Dunmore patent No. 1,606,212. Some criticism was made as to the effectiveness of the mid point connection 11 in the elimination of the hum in the output circuit. Will you state whether or not there is an ineffectiveness in this respect? A. This potentiometer 11 appears to be connected in the right point and I do not see any reason why it should not be effective.

Q37. To what extent would the fact that the rectifier supplying the current to the tubes which supply the output is a half wave rectifier interfere with the functioning of that portion of the apparatus? A. The choice between a half wave rectifier and a full wave rectifier is merely a matter of degree. A half wave rectifier can supply the current in the same manner as a full wave rectifier. If I understand the criticism correctly it is referring to the fact that half wave rectifier is operative only during one half of the cycle, while the other half presumably no current is passing.

That is only true to a certain extent, since, in the first place, the inductive effects in the smoothing circuit will tend to extend the period of operation of the rectifier and on the other hand the inertia of the magnetic field particularly in solid structure would tend to maintain the magnetic field which is used for the purpose of operation.

Q38. How would the values of the condenser 16, coil 17, function in this respect? A. Condenser 16 and the coil 17, which is the usual type of filter in combination with rectifier should be entirely effective to maintain a constant flow of current provided their magnitudes are chosen of the proper value.

Q39. And was it within the skill of the art at that time to properly select those values? A. This whole subject was very thoroughly discussed in literature antedating this patent by a good many years.

Q40. And in your opinion would it have been a matter of ordinary skill to have adjusted those values to get the desired constant potential? A. That was entirely within the skill of an engineer.

Mr. Barus: It seems to me that that is asking the conclusion of the witness as to what is the ordinary skill of an engineer. I have no particular objection to this particular question.

Mr. Edwards: It is opinion evidence.

The Court: I think the answer to the preceding question and this are intended to be identical anyhow.

Mr. Barus: Yes.

By Mr. Edwards:

Q41. Refer to the circuit in the same patent for supplying the power to the field of the loud speaker. Some criticism was made as to the obtaining suitable rectified current and the effect of the field magnetism upon the coil 9. Will you state how those parts of the system operate in that respect? A. Rectified alternating current which is supplied to the field magnet 10 is intended to produce a constant magnetic field. On account of the rectifier there is a possibility of fluctuations in that magnetic field. Such fluctuations would be detrimental to the operation of the loud speaker and must be taken care of some way or other. In this patent the coil 9, which is the operating coil, is described to carry a current which counteracts the effects of this variable field in such a way as to balance out this effect and give the correct operation of the loud speaker.

Q42. Now, will you go into that a little further and consider first the function or operation of coil 10 itself with respect to smoothing out fluctuations of the power circuit from the rectifier; how does that function? A. Coil 10 is an inductance and the inductance in any circuit tends to maintain the current constant. Moreover, in the usual types of loud speakers of this type, electrodynamic loud speakers, this coil 10 consists of a solid iron structure. A solid iron structure has the property of maintaining its magnetism in face of variations of exciting current on account of so-called eddy currents generated in the solid core. This would maintain the field constant.

Q43. Now, would the coil 10 itself be completely effective in making the current constant or would there be any residual fluctuation left over after the coil 10 itself has operated? A. There would be a certain residual fluctuation left over.

Q44. How does the flux of coil 9 operate with respect to that residual flux? A. May I express it in my own terms?

Q45. Yes, if you will. I would refer to it not as the flux of current 9, but as the current flowing through coil 9.

Q46. Yes. A. This current is arranged to carry a certain amount of fluctuation of the same frequency as the fluctuations of the field strength in the magnet 10. Also the circuit provides arrangement for adjusting the magnitude of these fluctuations; and the patent mentions the fact that the connections have to be arranged in such a relation that this current passes in the correct phase. Then the object of these currents is to react with the field in such a way that the pulsations of the field are ineffective. This is accomplished——

Q47. Ineffective in what region? A. Ineffective in producing any audible sound.

Q48. Is there any advantage or point in having this connection occur at the place where it does occur? A. There is a very decided advantage in applying the method of compensation at the point where it is most desirable to eliminate it. This coil is producing sound waves, and if there were any fluctuations left at this point, they would produce disturbing noises, and therefore at this point we are to eliminate. There may be added also that if it were attempted to eliminate those fluctuations at another spot, additional apparatus would be required.

Q49. Now, while we are on this subject, will you consider the Defendant's Exhibit 74, illustrating the loudspeaker 104 and the detailed sketch made by Mr. Waterman to illustrate the approximate position of the copper rings R1, R2 and R3, and compare that action with the action in the Dunmore and Lowell patent, to which you have just referred? A. The copper rings R1, R2 and R3——

Mr. Barus: I am wondering whether this is proper rebuttal testimony. Nothing was said about these rings or their having any function in this connection on the direct examination on the prima facie case, and now apparently they are introducing some theory about those rings being an infringement. I am wondering whether that is proper rebuttal.

Mr. Edwards: The defendant itself brought in these copper rings as an attempt to differentiate from the action of the patent. Mr. Waterman pointed out that according to his view the patent fields were opposite to each other, whereas, we claim that in the loud speaker 104 by reason of the copper rings, you get quite a different action. I think it is entirely proper for us to point on rebuttal that Mr. Waterman's view is incorrect.

Mr. Barus: I think some other theory of infringement than that advanced in the prima facie case ought not to be taken up at this time.

Mr. Edwards: This is no different theory from what was put in originally. The defendant came in and asserted the difference in this respect.

The Court: As I understand it, Mr. Barus, this is merely meeting directly the theory of the defendant's expert who tried to escape the conclusions advanced by the plaintiff. Am I wrong?

Mr. Barus: I think you are wrong there, because we were unable to find any conclusions in that respect advanced by the plaintiffs' expert which he could meet.

Mr. Edwards: Failing to find such, Mr. Waterman asserted some of his own and I think we are entitled to answer them.

Mr. Barus: I think that is correct, and I have no objection to talking about Mr. Waterman' conclusion; but it seems to me at this time to introduce perhaps some new theory of infringement that we have not had an opportunity to meet.

The Court: So far as advancing any new theory of infringement, that can not be done at this time, but I think they can meet it if the fact warranted or the theories warranted the theory advanced by your expert, and that is what I understand this is.

Mr. Barus: I have no objection to that, but I want to guard against introducing some new theory at this time unless we have an opportunity to meet it too.

Mr. Edwards: We have no new theory of infringement.

A. The copper rings R1, R2 and R3 are located in the immediate vicinity of the operating coil C, which corresponds to coil 9 of the patent. As I understand the operation of these rings, they are intended to have currents flow in them which counteract the variations, the pulsations, in the field magnet, in such a way that the operating coil C should not be subject to their influence, and therefore the output of the loud speaker would not contain the disturbing noise. The function of these rings R1, R2 and R3 in carrying currents which counteract the variations in the field, appears to me to be similar to the function of the coil 9 in the patent which also carries currents which counteract the fluctuations of the magnetism in the field structure.

Q50. Now, in that structure, the field coil operates to some extent to remove or smooth out the fluctuations from the rectifier? A. I find in the diagram, Defendant's Exhibit No. 74, that the field magnet is connected to the output of the rectifier, consisting of the two UX-216 B tubes with a condenser shunted ahead of this coil. It carries practically the full current output of this rectifier. Since this coil is an inductance, it will have to that extent the same effect as the inductance of coil 10 of the patent, which is the identical coil, so far as the loud speaker is concerned.

Q51. There will be some residual fluctuations notwithstanding the field coil in the loud speaker 104? A. There will be a certain amount of residual fluctuations in the current and therefore in the field structure of the loud speaker 104. That is exactly the object of those rings R1, R2 and R3, to overcome those fluctuations. Otherwise, there would be no object in putting them in.

Q52. And what in your opinion is the point or advantage of locating them at the place where they are located? A. Locating these rings next as close as possible to the operating coil C, is of very convenient and evident advantage in eliminating the pulsations of the magnetic force at the point where it is effective.

CROSS-EXAMINATION.

XQ151. What tests have you made in connection with alternating current loud speakers? A. My work on the loud speakers was mostly prior to the time when alternating currents were applied to it. In other words, it was mostly during my employment with the Westinghouse Company. The Dubilier Condenser Corporation,

of course, is not manufacturing loud speakers and therefore I had very little occasion to make tests on the loud speakers.

XQ152. Have you ever made any tests on the 104 loud speaker? A. I have listened only to the 104 loud speaker.

XQ153. That is in normal condition or some other condition? A. Under normal conditions, yes.

XQ154. So that all your testimony as to the 104 loud speaker is based on purely theoretical grounds? A. No I would not say that because during my employment with the Westinghouse Company, I had opportunity to test out and experiment very carefully with the operation of the loud speakers, I made a very thorough study of all the different types of loud speakers, and I can say that I am perfectly familiar with all the theoretical and practical consequences of the factors involved in the design of a loud speaker.

XQ155. But those loud speakers were not designed for alternating current operation, I understood you to say? A. At that time we were not considering alternating current loud speakers to any large extent.

XQ156. So that in so far as you are talking about the alternating current features you are speaking from theoretical considerations? A. Again I must say that that is not so because the factors involved in introducing alternating current in loud speakers are of the same nature and based on the same principles as the factors which enter into any kind of loud speakers. Fundamentally the loud speaker converts alternating current into sound and therefore you cannot separate really the problems of loud speakers from the problem of alternating current.

XQ157. And by alternating currents in that connection you are speaking of the audible frequency currents? A. All audible frequency currents, yes.

XQ158. I understood you in discussing the 104 loud speaker to state that the field coil of the magnet carried the full output of the rectifier. I assume you meant by that the full D.C. output, did you not? A. Yes, because part of the A.C. output in shunted by the condenser ahead of the loud speaker.

XQ159. And that is a very large part of it, is it not? A. That depends on the size of the condenser.

XQ160. And if the condenser is a 7 microfarad condenser it is a large condenser, is it not? A. It is a large condenser in the circuit and it would by-pass a considerable portion of the current.

XQ161. The greater part of the fluctuations? A. May I ask what the other condenser following the loud speaker what magnitude that is?

XQ162. Assuming it is the same? A. If you assume that the other condenser is of the same capacity than I would say that the major portion of alternating current would be by-passed by that condenser.

XQ163. Which condenser? A. The first condenser.

XQ164. So that in loud speaker model 104 by the time the current reaches the field coil, the fluctuations due to alternating current, have been greatly reduced, have they not? A. That is right.

(End of Stipulated Testimony.)

PLAINTIFFS' REBUTTAL.

Thereupon DR. FREDERICK W. LEE, recalled in rebuttal, testified as follows:

DIRECT EXAMINATION.

By Mr. Edwards:

The Witness: As to whether the Pridham and Jensen patent 1,105,924 shows a loud speaker operated by alternating current in which the current in the field coil is oppositively wound and in opposite phase to the armature coil or coil receiving the output from the radio set, I will say that in this patent I do not see any connection to any alternating current system nor do I see any method of making a connection with the armature circuit from an alternating current piece of apparatus or vacuum tube, nor do I see a method or indication of a method of reversal between the field circuit and the armature circuit I understand from the reading of the patent that in this circuit opposition occurs between two field coils and not between an armature coil and a field coil. The pulsating effects are so adjusted by the two field coils that the two armatures are acted upon by the two separate field coils. In these two separate field coils the pulsation may counteract or balance each other out, but there is no reaction between a pulsating current in the armature coil or a pulsating current in the field coil.

Reference has been made to a Hull filter and it is claimed that in the defendants' set there is a Hull filter interposed between the rectifier and the loud speaker coils which Hull filter eliminates all the hum, as to whether that is a possibility, I will say that the Hull filter consists of a condenser, an inductance coil and another condenser on the other side of that inductance coil. The Hull filter will not eliminate all the hum unless you have a large amount of energy available and a very, very large condenser on both sides, and also a very, very large inductance between the two. In other words, if you skimp on the size of condenser and skimp on the size of tubes supplying the service, or skimp on the size of the inductance it will not eliminate the hum. There is no objection from the standpoint of science to providing sufficient source and sufficient number or size of coils and condensers to smooth the current out so that there will be substantially no hum left; but there is a large objection from the standpoint of cost. Putting in large condensers, large choke coils, large tubes, enhance the cost of the set. While is is a possibility for the Hull filter to be made with sufficient number or size of elements to smooth out, the objection to it, to my mind, is the cost of it. The practice in commercial sets is to make everything as cheaply as possible without destroying the operation of the set. When that is done that leaves a substantial fluctuation in the current leaving that Hull filter. There usually is a substantial hum left which can be tested for by placing a telephone or amplifying apparatus at the end of the filter. With an expensive filter I can reduce the intensity of the hum to any desired amount, even beyond audibility. But if the filter is not an expensive filter then there is more or less residual hum.

Mr. Darby: I have no cross-examination.

The Court: I would like to ask you how it is—maybe you have already explained it—how you account for the fact that this model or this set that is claimed to have been brought out of commercial use,—and there is no testimony to the contrary, and it functions apparently all right here in this room,—how do you explain that that model, when listening to it has no more hum when you have the connection in one form than when you have it in the other? A. From the description as presented in the testimony that I have heard I would say that there was no

hum at the end of that filter circuit, but I do not know that as such unless I have tested it.

Q. Well, it is conceded, isn't it, that there is a difference in the plan of getting rid of the noise in this set and the set on which the plaintiff relies? A. I understand that both sets are identical but I have no——

Q. I am talking about the plaintiff's set. A. I beg your Honor's pardon.

Mr. Edwards: The one in the corner.

The Court: You do not depend upon the filter in that? A. No, sir, they depend upon compensation.

Q. Do they have the same filter device? A. They have the same type but not the same constants in their filter. In other words, they can skimp on the filter more than they could if it was necessary to have a one hundred per cent filter.

Q. Well, if the plaintiff concedes they do not rely upon the filter in their own device, and if it appears to be a fact, when you listen to what we call the second exhibit or model of the defendant's device, that there is not any appreciable difference in the hum when the connection is in one form than when it is in the other, doesn't it follow that the filter plays a substantial part in one machine and not in the other? A. Yes, but in the construction of a filter and coils there is often a great deal of difference between them although they apparently are made nearly alike. You may have considerably more inductance, or you may have a considerable difference in the constants, in the normal manufacture, and in one case you may not have any hum at all and in another product made more or less identical you may have a considerable amount of hum.

(Testimony of the witness concluded).

Mr. Brady: We are ready over here whenever your Honor is.

The Court: What do you want done now?

Mr. Brady: I want to show the quantity of hum in the Stewart Warner set.

The Court: Do you want it read into the record?

Mr. Brady: I want to put the test machine on the Stewart Warner set and have it observed and have the stenographer record what happens.

The Court: Is it something that can be listened to in a different way from the way I listened to the other?

Mr. Brady: Yes, you can hear it from your chair.

The Court: Very well. Which one is this?

Mr. Brady: This is the defendant's machine.

The Court: They have two machines.

Mr. Brady: The defendant brought in but one No. 109.

The Court: It is identical with the one that you have been using, I understand, the same model?

Mr. Edwards: They say so. We do not know.

By Mr. Brady:

Q. What is that we hear? Will you explain just what the operation is by referring to a circuit diagram?

PERCIVAL D. LOWELL recalled.

DIRECT EXAMINATION.

Mr. Lowell: We have now the loud-speaking test apparatus across the output of the filter. The leads to the test apparatus are connected across the output of the filter circuit of the Stewart Warner receiver. Apparently the change of noise is due to putting it across the filter. In other words, there is a residual hum here when we connect one side to the receiver, or when we connect the full input of the defendants' apparatus on it changes into a hum of a slightly different pitch, and that is the hum which you hear from the filter. The hum you hear now is with the defendant's apparatus not connected across the filter. When we connect it across the filter you will notice there is a smoother hum which comes in.

The Court: When you say "across the filter", do you mean after the filter has done its work? A. Yes, that is correct.

Mr. Brady: The circuit diagram referred to by the witness is offered in evidence as Plaintiffs' Exhibit 109. (Received and marked "Plaintiffs' Exhibit 109").

The Witness: The circuit diagram I have identified is a fair representation of the test I have conducted.

CROSS-EXAMINATION OF MR. LOWELL.

By Mr. Darby:

Q. Would you say that there is more hum in this loud speaker when it is not connected across the output than when it is connected across the output, and I now have it so that it is not connected across the filter at all and I ask you to listen to it. Now, I will connect it. Now, which do you say is the loudest? A. I say there is more 120-cycle hum when connected across the filter than it is without.

The Witness. This apparatus, test apparatus, consists of a loud speaker and three stages of vacuum tube amplification. There are six tubes in that test set. There are three stages of amplification and as nearly as I can tell there are two full wave rectifiers. I have not examined this diagram before. There are four amplifying tubes, three amplifying stages, in this set, and after amplifying that hum during all of these stages of amplification, you get this hum that we hear.

Mr. Darby: This is an A. C. amplifier.

Mr. Edwards: In rebuttal, your Honor, I would like to have this test run with a battery device. Apparently Mr. Darby is objecting——

Mr. Darby: No, sir. I am not objecting.

The Court: I will have to test it, after all, mostly by my own ear.

Mr. Edwards: Mr. Darby has criticized this because the amplifier is an A. C. amplifier and has some hum itself, and if we connect up batteries that is out.

The Court: But it is really the human ear that we are concerned with.

Mr. Edwards: Not quite, your Honor, because it is whose human ear which is to be satisfied and whether you are satisfied under conditions of noise or in a quiet room.

The Court: Relatively speaking, doesn't this testing machine bear out what the human ear hears, namely that most of the noise, or a major part of it, is eliminated before you get to the loud speaker?

Mr. Edwards: No, I think that is where we differ. We insist that that test that we have just made shows that after you leave the filter and before you get to the loud speaker there is a very substantial hum. Mr. Darby criticizes that tests because he said the loud speaker itself is putting in some of the hum because it is an A. C. speaker. We offer to meet that by running it with batteries instead of A. C., so that there will be no hum in the amplifier itself. That is our offer.

The Court: I do not think it is necessary.

Mr. Darby: I agree with your Honor. I made no criticism whatever. I wanted the record to show what the facts were. We rest our case.

(Evidence concluded).

At this point the Court ruled orally that the patent 1,606,212 is valid and infringed. The views expressed by the Court in so ruling are embodied in the final opinion of the Court on file in this case.

The aforegoing Statement of Narrative Evidence is hereby approved.

SEMMES, BOWEN AND SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Plaintiff.

C. V. EDWARDS,
Of Counsel.

COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Defendant.

SAMUEL E. DARBY, JR.,
Of Counsel.

Approved this 12th day of December, 1934.

WILLIAM C. COLEMAN,
U. S. District Judge.

PROFFER OF EVIDENCE UNDER RULE 46.

(Style of Court and Title Omitted.)

Plaintiffs offer to prove the following by the following named witnesses:

HARRY R. VAN DEVENTER, that he resides in the City of New York; that in October, 1924, he was Vice-President of the plaintiff Dubilier Condenser Corporation and negotiated the agreement identified as Plaintiffs' Exhibit No. 4, now on pages 25 to 40, inclusive, of the Record on Appeal in the case of Radio Corporation of America vs. Dubilier Condenser Corporation, hereinafter referred to as Radio Corporation Appeal Book; that at the time of negotiating said instrument plaintiff examined and heard in operation the receiving set marked Plaintiffs' Exhibit No. 48, and that the photograph, Plaintiffs' Exhibit No. 47 is a copy of said instrument; that at that time there was no alternating current operated radio receiving instruments on the market; that the Dubilier Condenser Company, after negotiating and executing said agreement, designed and caused to be marketed a B-battery eliminator, described and shown in the Catalogue marked "Plaintiffs' Exhibit No. 7"; that the circuit of said eliminator is shown in the blueprint marked "Plaintiffs' Exhibit No. 7-A"; that one of the said super-ducons is produced as a physical exhibit and marked "Plaintiffs' Exhibit No. 7-B"; that the reason the plaintiff manufactured only a B eliminator and not an eliminator for A and C batteries was that at the time the only receiving sets on the market were crystal receivers, which did not employ vacuum tubes, regenerative receivers in which the plate circuit fed back to the grid circuit, and in consequence no A battery eliminator or C battery eliminator would be effective to avoid the hum of the power current; and a type known as Neutrodyne receivers, which were subject to oscillation under very critical conditions, and to which neither A battery eliminators nor C battery eliminators could be applied without making extensive changes in the sets. Therefore, as a commercial proposition the Dubiliar Company was confronted with the necessity of making radio receivers complete, which it did not have the capital to do, and which would compete with its condenser

customers, or, on the other hand, making only a B eliminator which could be used with most of the receiving sets of the old type then on the market, leaving new sets to be manufactured by radio set manufacturers, embodying both A and B and C eliminators. The Dubilier Company spent upwards of $300,000 developing these "Superducons" (Battery eliminators) which were put upon the market in the year 1924, and continued for several years thereafter. Difficulties were encountered in obtaining tubes and in the meantime, in the latter part of 1926 or 1927, the Radio Corporation came upon the market with complete receivers, which were sold in such large numbers as to reduce the possibilities of the eliminator as a separate unit. The majority of radio sets on the market previous to that were of the regenerative type. The exhibit marked "Plaintiffs' Exhibit 8" is a type R. A. tuner and type D. A. audio amplifier, comprising one of these sets as put out by the Radio Corporation, which were manufactured and sold by the Westinghouse Electric Manufacturing Company, which made the set. The loud speaker, marked "Plaintiffs' Exhibit 9" accompanied this set. This set was operated entirely by batteries, a storage battery for the filament supply and large dry-cell batteries for the plate supply.

FRANCIS W. DUNMORE, I am a physicist of the Bureau of Standards in Washington, D. C., where I have been employed since 1918, at which time I met P. D. Lowell, the co-inventor of Letters Patent 1,455,141 and 1,606,212; I became interested with my co-inventor Lowell in the invention relating to the patents and my patent 1,635,117 during the summer of 1921, at which time I determined with his co-inventor Lowell the desirability of eliminating batteries in radio receiving apparatus for broadcast recepton in the home using the ordinary 60-cycle house residence lighting power; that the matter comprising Defendants' Exhibit No. 1, and shown on pages 459 to 485 of Volume 4 of the said Radio Corporation Appeals Record, are correct copies of time cards made by me on the dates specified on the said entries, and now produces the originals of said entries; that the matter between pages 487 and 517 are correct copies of monthly reports made by me on the dates shown thereon; the entries appearing on pages 519 to 538 forming part of said Exhibit 1, are correct copies of notebook entries made by me on the dates appearing thereon. I

produce the original time cards, notebook entries, monthly reports and laboratory reports corresponding to the copy appearing in this record, and offer the same as Plaintiff's Exhibit No. 14 in this case.

Mr. Percival Lowell and I conceived the invention of Letters Patent 1,455,141 on September 28, 1921. There is an entry on my time card for September 28, 1921, page 463 of the Radio Appeal Record. We made a bread board model, which later was put into the set illustrated in the photograph, which I offer as Plaintiffs' Exhibit 15. The circuit of this apparatus is shown in my notebook entry of October 7, 1921, on page 41 of the notebook, forming part of Plaintiffs' Exhibit 14. After having supplied the raw alternating current to the filaments of the tubes, as illustrated in my notebook entry on page 41, Lowell and I proceeded to eliminate the B battery, and for that purpose we constructed a filter, employing a seven henry choke, a ten microfarad condenser, a 32,000 ohm resistor and two receiving tubes acting as a full wave rectifier, 60-cycle alternating current was supplied to derive rectified current, which was filtered and supplied to the plate circuit of electron tube receiving apparatus, as illustrated in my notebook on page 46, under date of December 8, 1921, page 524 of the Radio Appeal Record. (Exhibit 14.)

By November 23, 1921, the type A relay (Plaintiffs' Exhibit 15) was operated on a Teletype radio printer receiver, by which signals were received in print successfully at the Bureau of Standards from the Naval Air Station at Anacostia, Washington, D. C., in the presence of naval officials, and as described in the article in Radio News for November, 1922, Plaintiffs' Exhibit 59, Radio Appeal Record, pages 219-222.

The completed drawing of the A type relay is offered in evidence as Exhibit 16, shown on page 805 of the Radio Appeal Record.

After Lowell and I had operated the B battery eliminator system shown in my notebook, page 46, on December 8, 1921, we proceeded to assemble a complete radio receiver operating entirely without batteries, which we operated without A and B batteries December 10, 1921, in the presence of John P. Buckley, R. S. Ould, Francis H. Engel, H. A. Snow, Francis M. Baer and others.

This radio receiving apparatus successfully operated to receive phonograph concerts transmitted by the Naval Radio Station at Anacostia, D. C., using 60-cycle alternating current to energize the filament and plate circuits without interference from hum from the alternating current.

Having operated the alternating current power supplied receiving apparatus on December 10, 1921, Lowell and I continued to experiment with the apparatus and proceeded with the construction of a compact form of apparatus embodying our circuit of December 10, 1921. We were actively engaged in building the apparatus during the months of January, February and part of March, 1922. The apparatus was completed prior to March 10, 1922, as shown in photograph Plaintiffs' Exhibit 17. Lowell and I successfully operated this apparatus and gave many demonstrations of the apparatus. The circuit diagram for this apparatus is illustrated in Exhibit 18, and shows the three stages of radio frequency amplification, the detector and the two stages of audio frequency amplification employed in the Bureau of Standards set. In our December 10, 1921, apparatus we employed an electron tube detector; and we provided hum eliminating means for each of the sections of the radio receiving apparatus.

The Bureau of Standards receiving set illustrated by Exhibit 17, as shown in the circuit diagram Exhibit 18, is here, and I produce the same and state that this apparatus is in the same condition as it was when originally constructed and completed the early part of March, 1922. This receiving set and the associated rectifier unit are marked in evidence as Exhibits 19 and 20, respectively.

Here is the antenna which Lowell and I used in demonstrating the apparatus, Exhibits 19 and 20. This is a flexible canvas rolled type of antenna, where the wires are sewed in the canvas. My wife sewed this antenna, so that we could make tests of the apparatus in many different localities, with the antenna in portable form. We did a great deal of work on the alternating current radio receiving apparatus away from the Bureau of Standards, and the photograph Exhibit 29, which I offer in evidence, shows part of my home laboratory equipment which we used in some of our developments.

The receiving apparatus received wide publicity; and I refer to publications describing this apparatus which appeared in the Journal of the American Institute of Electrical Engineers for July, 1922, pages 488, 489, 490; the article in Radio for September, 1922, page 27; the article in Telephony for September 16, 1922; the article in Q. S. T. for October, 1922; the article in Radio News for September, 1922, page 441; and the newspaper publications in the New York Times for April 25, 1922, Washington Star for April 24, 1922, New York Globe for April 25, 1925, Washington Herald for April 14, 1922, and Washington Post for April 25, 1922, which articles I have grouped and offer in evidence as Exhibit 21.

On December 3, 1921, I had conceived the invention of Patent 1,635,117, as shown by the entry on my time card for December 3, 1921, page 467 of the Radio Record.

By December 16, 1921, I worked out the complete circuit ~~in~~ the Patent 1,635,117, and successfully operated the circuit, as shown on page 51 of my notebook, Radio Appeal Record 526. After working out the circuit on December 16, 1921, I proceeded with the construction of the apparatus of the invention of patent 1,635,117, which apparatus is shown in the photograph which I offer as Exhibit 22. The actual apparatus as set forth in the photograph Exhibit 22 is here, and I now refer to the same, and offer this as Exhibit 23. This apparatus successfully operated early in 1922, and eliminated A, B and C batteries. The apparatus embodied the element of the resistor shunted by a condenser and connected in the circuit between the grid and cathode for impressing a negative potential upon the grid. The invention of Letters Patent 1,635,117 was widely described in publications; and I refer to the article in the American Institute of Electrical Engineers describing this apparatus, which appears on pages 199-203, Radio Appeal Record; Radio for March, 1924, page 807 of the Radio Appeal Record; Radio News for July, 1922, pages 814-817, which are offered as part of Exhibit 53. I refer to the article in the Journal of American Institute of Electrical Engineers, published April, 1922, pages 242-246, which article I offer as Exhibit 53.

After completing and successfully operating the Bureau of Standards set, Exhibits 19 and 20, I collaborated

with Lowell in his work at the Radio Instrument Company in Washington, D. C., where he constructed a radio receiving apparatus operating from the alternating current, which apparatus I now offer in evidence as Exhibits 24 and 25. Exhibit 24 comprises a J. M. 6 amplifier, employing three radio frequency amplifier stages and electron tube detector and two audio frequency amplifier stages powered with alternating current from the rectifier unit Exhibit 25, supplying raw alternating current to the filaments and rectified on the current to the plates.

Lowell and I were under contract to develop alternating current radio receivers with the Radio Instrument Company for a year, which terminated in June of 1924. During the summer of 1923, and shortly after the issue of our patent 1,455,141 on May 15, 1923, we constructed the apparatus, which I now offer in evidence as Exhibit 26. The apparatus is in the same condition as it was when completed in December, 1923, except for the fact that I have substituted a filter choke for a burned-out choke, and I have substituted a fresh rectifier tube for a deteriorated tube. It will be noted that this set comprises three stages of radio frequency amplification and electron tube detector and two stages of audio frequency amplification. The radio frequency amplifier stages and the stage between the last radio frequency amplifier stage and the electron tube detector are coupled through means which strain out any hum frequencies and prevent the transfer thereof through the receiving set. The circuit diagram for this apparatus is shown at page 187, Plaintiffs' Exhibit 50, Radio Appeal Record.

I now operate this apparatus and demonstrate the fact that the apparatus functions without A or B batteries, with the tubes powered from 60-cycle alternating current, and without hum. In order to show that the alternating current is energizing the circuit of the apparatus I now make mal adjustments of certain of the hum eliminating devices, and it will be observed that the hum so shrouds the signal as to impair the condition of the modulation of the received broadcast signal, as to make the reception impracticable. However, by correcting the adjustment of the hum eliminators it will be seen that the set now operates quietly and without hum for the reproduction of broadcast programs. I demonstrated this apparatus,

Exhibit 26, to Dubilier Condenser and Radio Corporation, including Mr. H. R. VanDeventer. In the early spring of 1924 I demonstrated the apparatus to Mr. Powell Crosley, Jr., and Mr. George Lewis of the Crosley Radio Corporation, Cincinnati, Ohio. The apparatus functioned satisfactorily, but Mr. Crosley prophesied that in the light of the battery operated receivers which he was then manufacturing, that any radio receiver operating from alternating current would be so complicated as not to be possible in quantity production. At the time of building the apparatus of Exhibit 26, Lowell and I found no parts such as power transformers or rectifier tubes capable of performing the function of alternating current operation of a radio receiver, and it was necessary for us to design the power transformer, and have the American Transformer Company of Newark, New Jersey, build the transformer from our specifications. We asked the General Electric Company and Westinghouse Electric Manufacturing Company for rectifier tubes to use in the rectifier system of the receiver of Exhibit 26, and we were told that there were no such tubes available. We therefore had to resort to receiver tubes and tied the grid and plate together to secure in effect a two-electrode tube to function as a rectifier power supply system.

We called the attention of the Freed-Eisemann Radio Corporation to our said Exhibit 26, and they requested us to apply the principles of operation of our alternating current operator receiver to the standard Freed-Eisemann neutrodyne. For this purpose Joseph D. R. Freed sent to us a standardized neutrodyne in April, 1924. We proceeded to the preparation of specifications for a new power transformer, and had this manufactured by the American Transformer Company of Newark, New Jersey. We rewired the Freed-Eisemann Neutrodyne and built a power supply circuit, which apparatus is now here, and I offer in evidence Freed-Eisemann Neutrodyne rewired for operation on alternating current as completed by Lowell and me in June, 1924, as Exhibit 27. The rectifier unit for the Freed-Eisemann Neutrodyne is offered in evidence as Exhibit 28. When we had completed this neutrodyne rewired for operation on alternating current, Joseph D. R. Freed came to Washington, and we demonstrated the apparatus to him. The demonstration was completely successful, for the neutrodyne

operated on alternating current without hum. The photograph on page 181, Radio Appeal Record, Exhibit 49, shows the neutrodyne apparatus of Exhibit 27 and the rectifier unit of Exhibit 28, which we successfully demonstrated to Joseph D. R. Freed in June, 1924. We sent this rewired neutrodyne, Exhibits 27 and 28, to Freed-Eisemann Radio Corporation, but we were informed that due to the patent situation they were not immediately interested in proceeding with the production of the apparatus, due to possible infringement of patents held by the General Electric Company, and under which Freed-Eisemann Radio Corporation was not at that time licensed. We withdrew the apparatus from Freed-Eisemann Radio Corporation and demonstrated this to others, as a result of which licenses were extended to Dubilier Condenser Radio Corporation, the Argus Radio Corporation, Timmons Radio Products Corporation, Brandes Products Corporation, Philadelphia, Storage Battery Company, Grigsby Grunow Company, Elkon Works, Inc., Fansteel Products Corporation, Willard Storage Battery Company, which companies manufactured B battery substitutes and built radio receiving apparatus in accordance with our patents under license.

FREDERICK W. LEE will testify as follows:

I graduated in 1911 from Cornell University, where I specialized in Electrical Engineering. After hat, I entered Harvard University as assistant to Dr. A. E. Kennelly, who was the discoverer of the Kennelly-Heaviside layer, a very important phenomenon directly related to radio transmission. The theory of radio and the associated circuits constituted the major portion of my work at that institution. In 1914 to 1915 I was engaged upon the application of radio to geo-physical prospecting. This work was done at the Johns Hopkins University, Baltimore. In 1916, I joined the Engineering Faculty of the Johns Hopkins University and I remained with that institution until 1928. While at this institution I was Associate Professor of Electrical Engineering, having direct charge of courses in radio and alternating current. I received my Doctor's Degree from the Johns Hopkins University in 1920. From 1928 to 1932, I have been associated with the Johns Hopkins as Research Associate, having charge of problems relating to radio in connection with Doctor's Dissertations with students in the gradu-

ate department. At the present time I am engaged in consulting capacities in various technical fields or enterprises, having to do with the use of electricity, especially as it relates to oscillatory circuits and vacuum tubes. During all this time I have closely followed the development of wireless telegraphy and telephony.

In the art of radio the first receivers up to 1922 consisted essentially of amateur sets employing *crystals.* These were supplemented by vacuum tube sets as soon as such tubes became commercially available by the amateurs and also by well-recognized firms as the Westinghouse Company. The Westinghouse Company in this connection was functioning in a joint agreement with the Marconi Company, the General Electric Company, the United Fruit Company, the American Telephone & Telegraph Company and its subsidiary, the Western Electric Company. The best talents of these organizations had concentrated their efforts upon the production of a suitable broadcast receiving set. The culmination of such efforts was the introduction into the market of the Westinghouse receiving set, known as the Aeriola Junior and the Aeriola Senior.

The Aeriola Junior was a crystal receiving set, with a tuned circuit. The Aeriola Senior was a vacuum tube receiving set, using the regenerative system. This was followed by a set called the Type D. A., which consisted of a two-stage detector and amplifier. A short wave regenerative tuner known as Type R. A. was connected to this set. In this set there was no radio frequency amplification other than that received by regenerative action in the detector tube. This set operated upon a storage battery of six volts and a B battery.

The circuit and arrangement of the crystal detector set is illustrated in a book entitled "Radio Phone Receiving", published in 1922 by D. VanNostrand and Company, a copy of which I produce and mark "Plaintiffs' Exhibit 60", on pages 73, 74, 75 and 76, a copy of which I produce and mark "Plaintiffs' Exhibit No. 61."

This set did not use batteries. It depended for its operation upon the fact that the current flows only in one direction through the crystal. This type of set was known as the Aeriola Junior. The Aeriola Junior crystal set is further described on pages 175 and 183 of a book

entitled "Textbook of Radio" published in 1922 by the Technical Book Company of New York City, a copy of which I produce and mark "Plaintiffs' Exhibit No. 62." I also produce and attach a photostat copy of several pages, 175 and 183, and mark the same "Plaintiffs' Exhibit 63".

The Aeriola Senior is described on pages 185 and 186 of the said Textbook on Radio, a copy of which I attach and mark Plaintiffs' Exhibit 64, and also on page 134 of the said Radio Phone Receiving Book, a copy of which page 134 I produce and mark "Plaintiffs' Exhibit 65."

The Aeriola Senior was what is called a regenerative set; that is, as shown by the circuit, Figure 51 on page 134, the plate circuit was coupled to the grid circuit, and therefore feeds back into the grid circuit any high frequency signal which is applied to the tuned circuit.

Another set of this same regenerative type put out by the Westinghouse Company at about this time consisted of the D. A. detector and amplifier connected to a R. A. tuner. This type is described in the said Textbook on Radio, pages 177, 178, 179, 180, 181, 182 and 187, a photostat copy of which I attach and mark "Plaintiffs' Exhibit 66".

One of these R. A.-D. A. instruments is here before me, Marked "Plaintiffs' Exhibit 8". A loud speaker put out at about the same time and used in connection with the R. A.-D. A. receiving set is also before me, Marked "Plaintiffs' Exhibit 9".

The circuit of the D. A. detector and amplifier is shown on page 179 of the said Plaintiffs' Exhibit 66. This circuit consists essentially of a detector tube which I mark "A", followed by two audo amplification tubes, B and C. The detector tube receives the signal from the antenna circuits and uses a feed back from the plate circuit to the grid, amplifying thereby the incoming radio signal. This amplification is made sufficiently large that the potential on the grid rises high enough, but not sufficiently high as to cause regeneration in the form of oscillation in the incoming circuit. In other words, the potential of the grid is raised greatly beyond that which would be there, considering the incoming signal without the

regeneration. If alternating current were supplied to the filaments and plates of this circuit, the difference of the potential caused by the alternating current in the filament reacting back upon the grid would introduce a variation of potential which would reflect itself into the plate circuit, producing a large amount of hum. If alternating current be supplied to the plate circuit of this system, the current would only flow during one-half of the cycle; that is, when the plate is positive, and since this voltage would be of an alternating current nature, the plate current itself would change proportional to this voltage, and its variation would be amplified and pass through the circuit as hum. These variations so far transcend signal energies that it may be said that no signal comes through at all, but only hum.

I offer to connect up these sets and give a demonstration, to show that the application of alternating current to these sets would only result in drowning out any signal by excessive hum.

The patentees, in order to devise a set which would be operable upon household alternating current, employed the construction shown in Patent 1,455,141. I offer a photostat, which I mark Plaintiffs' Exhibit 67, which contains at the lower portion a reproduction of Figure 1 of the Patent in suit.

This patent consists of a radio receiving set, in which the functions of operation may be divided into three parts. The imput is first served to the radio frequency amplifiers, from which the signal enters into the detector portion of the system, and is thence transferred to the audio frequency amplifiers to the telephone receiver. In this system both the filament, as well as the plate circuits, are energized from the ordinary A. C. house current through a transformer. In the radio frequency amplifier section of this set the signal is impressed upon the grid of the first tube, Tube No. 3, and then to the second tube, Tube No. 5. The principle of operation is such that while it is impossible to entirely eliminate all the effects of audio frequency hum in Tube No. 3, the frequency of the power supply may be either 60 cycles or 120 cycles, depending upon whether the full wave rectification or half wave rectification—the patent shows halfway rectification, and is of audible frequency. The incoming high fre-

quency modulated wave is of the order of 600,000 cycles per second, which is beyond the audible range of hearing.

In order to illustrate what is meant by a modulated carrier wave, consider the portion A of Exhibit 67. It is noticed here that the frequency disclosed in this portion of the diagram has a variable amplitude. This variable amplitude between the interval a and b in the circuit may be considered the modulation of the carrier wave. Ordinarily the carrier wave without modulation would have the same amplitude through the total interval a-b as shown in B between the intervals a and b as of A. This gradual variation of amplitude represents the super position upon this carrier wave of the voice frequency. In order to function properly it is necessary that this voice frequency modulation be amplified by the first tube and passed on through radio frequency transformer No. 4 to a second tube where it is further amplified and passed on to transformer No. 6. The patent teaches that in this operation any modulation which may arise from the filament current should be carefully avoided, since once such modulation is introduced upon the carrier wave, it can not be removed from the signal by any means; also, that if such modulation be applied to the carrier wave, the incoming signal modulation is also destroyed, thereby resulting in two bad effects: One, the introduction of hum, and the other, the destruction of the signal. In addition to this phenomenon of carrier modulation and distortion, the tube 3 will also amplify any low frequency 60-cycle voltage which may be applied to the tube between the grid 3 and the filament and be passed on through the coupling between tubes 3 and 5 to the following stage. This patent relates that of all the possible couplings, of which there is a large number, between the tubes 3 and 5, choose that coupling which transmits only high frequency carrier wave, and block or strain out all of the low frequency of 60-cycles, so that considering the grid of tube 5, none of the 60-cycles which may be applied to the plate circuit of tube 3 is applied to the grid of tube 5. The order of the signal strength as received by tube 3, compared to the order of the hum introduced by the difference of potential between various portions of the filament and the grid, and also from the rectified portion of the alternating current applied to the plate circuit is of a much higher order, in other words, the hum frequency

signal is 100 times stronger than the signal received from the incoming wireless wave.

The patent here teaches to amplify the signal strength until it exceeds any hum strength, by first keeping the hum down originally as much as possible, and, second, straining it out between the separate high-frequency amplifying stages.

In order to reduce as much as possible the 60-cycle hum introduced by the variation of the filament voltage and the grid, a mid connection is applied in this filament circuit, so that the average potential between the two sides of filament and the grid does not change. Theoretically it is possible to select that point 17 in such a way that no hum would be introduced by the variation of voltage in the filament circuit with reference to the grid. Actually there is always the small remaining voltage, which is the order of thousandths of a volt—a millivolt—which can not be removed this way. In this grid circuit there is a condenser and resistance combination 29, which is connected to the grid circuit 3, so that the tube 3 will always have upon the grid a negative potential, that is, a small amount of hum, which can be exactly balanced out by the mid point 17, and serves to put the tube 3 in the proper condition for amplification, by making the grid 3 slightly negative. However, point 17 is selected so as not to make this hum voltage applied to grid 3 of a very great value, as would, for example, occur if the mid point of the resistance were not properly selected. Similarly, after the signal has passed through the vacuum tube 5, any hum that may be introduced by this tube is strained off again by another or second radio frequency transformer, which removes all the hum frequency introduced by the grid and plate circuits of tube 5. Of course, it will be understood that in some sets that only one tube will be used in this radio frequency portion, and in others two or more tubes may be used. The number of tubes is merely a matter of addition, the important feature being the amplification of the signal frequency, keeping out as far as possible the introduction of 60-cycle or 120-cycle frequencies by means of the mid point connection, which mid point connection at resistance 17 also acts to prevent the signal from being distorted. The signal having been amplified in its radio frequency portion, it is passed through the radio frequency trans-

former, where the power supply frequency is strained out. The signal passed into the second portion, the detector portion of the circuit, is now substantially free from any hum, and the detector portion itself, consisting of a crystal detector, does not introduce hum into the system; yet, there may be hum introduced into the system, due to the proximity of these circuits to adjacent circuits carrying raw alternating current; and provision is made herein by condenser 9-A to strain off any such hum introduced into the detector portion of the circuit. The function of the detector circuit is to bi-pass the high frequency or carrier wave through condenser 10; but at the same time to allow the signal to go through the audio frequency transformer 11, which being an iron core transformer passes only the low frequency, known as the audio frequency, to the next tube 13. In this next tube 13 the signal is again amplified, this time as audio frequency, and passed into the audio frequency transformer 36. From this audio frequency transformer it is passed to the last vacuum tube amplifier 37, also an audio frequency amplifier. In both grid circuits of vacuum tube 13 and 37 the midpoint connection is made to the filament circuit, which prevents the introduction of hum upon the grid circuits of the respective tubes; and even though a very small amount of hum were applied to these grids, the signal strength by this time would be so great, compared to this hum, that it would be of no consequence, that the hum would not be heard. It will be seen that in the instrument as a whole, the signal strength is progressively increased to an amplitude above any possible hum frequency. At the same time the hum frequency is strained out before the signal reaches the detector, and precautions are taken to keep out hum frequency as far as possible from the several stages of the instrument. In this manner the underlying idea is to get the signal strength well above the possible hum frequency strength, and to strain out and keep out the hum frequency. It will be understood that when speaking of hum I refer to the 60-cycle or 120-cycle frequency which comes from the household alternating current applied to the filament circuits of the tubes, or through the rectifier, and delivered to the plate circuits of the tubes. It will be remembered that a frequency of 60-cycle or 120-cycle is audible to the ear; and when these frequencies get upon the circuits, especially when they are applied to the grid circuit or to the

plate circuit and passed to the grid of a succeeding tube, they are amplified and appear in the loud speaker as an audible hum, which, unless eliminated by the means above described, would drown out the signal. It will also be understood that unless precautions are taken in the radio frequency stage, where the signal is weakest, by such means as the mid point connection of the grid, as indicated in the patent, the tube will be caused to operate in such manner that the signal will be distorted; and if once distorted the distortion can not be eliminated in subsequent stages of the instrument, even with the use of radio frequency transformers. Another point to be kept in mind is that if in place of radio frequency transformers some other well-known form of coupling is used between the radio frequency portion of the instrument and the detector, such, for example, as capacity couplings, resistance couplings, or certain other couplings commonly used, the effect above described would not be obtained. In such case hum distortion would be carried through one tube to another and in the final stage you would have hum amplified to the same strength that you had signal strength amplified, and since the signal strength is only a very small fraction compared to the hum strength, no signal would be heard at all. If these portions of the instrument be separated, the hum will not be eliminated. For example, if the radio frequency portion alone is employed, the signal being connected to the input and a telephone loud speaker to the output, the signal would not be heard, but the high frequency carrier wave would be heard as a hiss, if heard at all. In all probability, however, the 60-cycle or 120-cycle hum, which would be picked up by the wires in the radio frequency portion would drown out this signal, so that all that would be audible would be a low frequency hum.

Now, in like manner, if the detector portion were used alone, the signal being applied to the input and a loud speaker or telephone applied to the output, the signal, if heard at all, would be rectified, and therefore distinguishable as dot and dash or speech. But the power frequencies picked up by the wires of the system would, if the system were connected to an alternating current supply, drown out the signals so that all that would be heard would be a hum. If now these two portions are connected together, one would expect twice as much hum; but in point of fact, the hum would disappear. The rea-

son for this is that under these circumstances the power frequency would be strained out between the radio frequency portion and the detector portion, and the signal would be greatly intensified by the radio frequency portion, so that we would have a robust signal passing through the detector, the strength of which would be well above the hum frequency.

Now, likewise, if the audio frequency portion were employed alone, all that would be heard would be the low frequency passing through the signal, in the form of a carrier wave, and there being no detector it would not be heard as speech or music, but the 60-cycle or 120-cycle imposed by the power frequency would drown out the input frequency, so that all that would be heard would be a substantial hum. But if this same audio frequency portion is connected onto the detector portion as above described, and the radio frequency portion, as above described, the result will be that there will be delivered to this audio frequency portion a signal greatly exceeding in strength any possible hum frequency that could get into the audio frequency; and the resultant output of the instrument as a whole would be an undistorted, greatly amplified signal, and an undiscernible hum frequency. Therefore, these hum eliminating means are in no sense mere additions of hum eliminating means to the several portions of the set, and do not act the same when the portions are separate from each other as they do when combined. When combined they form a homogeneous humless set, whereas, taken separately each one hums in a most objectionable way.

I am prepared to demonstrate this, and have before me a model in which we have a set-up of several portions of the instrument. In this model the part marked "A" contains parts corresponding to the similar parts in the radio frequency portion of the Lowell-Dunmore patent. The portion B contains the detector portion, together with the radio frequency transformer and the condenser 9-A, as set forth in the patent. The part marked "C" contains the audio frequency portion of the instrument, and the parts correspond to those shown in the Lowell-Dunmore Patent; that is to say, the input iron core transformer, the tube and the output transformer. The portion marked D. H. J. contains connecting conductors adapted to connect the parts of the three portions of the

instrument to the rectifier device marked "F", to supply rectified current for the plate circuits, and to a transformer portion "E", adapted to supply alternating current to the filaments of the several tubes.

This model is so arranged that we may operate each portion of the instrument separately or altogether. The model also comprises a panel G, which substitutes a three electrode vacuum tube in place of the crystal. When this panel G is substituted in the place of panel B, for example, the wires of the connecting board will be found to connect the plate filament and input circuits of the panel to the power units "E" and "F."

We also have another panel marked I, containing an indirect heated type of tube, operating as a detector in place of the direct heated tube in panel G. When the panel I is substituted in place of B or G the connections connecting board D, H and J will connect the power supply units E and F to the input heater and output circuits of the tube.

I mark the various parts of the model A to J, inclusive, as Plaintiffs' Exhibit 68.

In order to follow the circuits of the various parts illustrated in this panel, we also have colored diagrams, in which the diagram A, B, C, I and G show the wiring on the corresponding panels of the model. The diagrams E and F show the wiring on the power supply units and the diagrams D, J and H show the active connections between the power supply and the panel units; D shows the connections when the crystal panel B is employed; H shows the connections when the panel G is employed; and J shows the connections when the panel I is employed.

The diagrams A to J, inclusive, I mark as Plaintiffs' Exhibit No. 69.

In order to show these various circuits simply and collected together, I also produce diagrams showing the circuits in place when the panels A, B, C, D, E and F are employed. This diagram I mark "Plaintiffs' Exhibit No. 70." Another diagram shows the circuits when panels A, G, C, H, E and F are employed. This diagram I mark "Plaintiffs' Exhibit 71." And another diagram shows

the circuits when the panels A, I, C, J, E and F are employed. This diagram I mark "Plaintiffs' Exhibit 72."

In all of these diagrams, as in the model, the input circuits are colored green, the heater or cathode circuits of the tube are colored red, and the output circuits are colored yellow.

I have operated the panels of this model separately and collectively, and am prepared to so operate the model in the presence of the Court and counsel for defendants. And such operation shows that when panel A is employed singly and the signal is applied to the input and a loud speaker or telephone applied to the output, there is heard a very loud, pronounceable hum. Such carrier frequency as is heard is very faint, and manifested only as a hiss, if heard at all. When the panel B is employed alone, and the signal connected to the input transformer and a loud speaker or telephone connected to the output of the crystal, all that will be heard will be a faint signal. If either of the panels G or I is employed alone, the signal being applied to the input transformer, and a loudspeaker or telephone connected to the output, the signal, if heard at all, will be in the form of speech or music, but the 60-cycle and 120-cycle hum frequency from the power unit will be so strong as to give out a substantial hum, and no signal at all. If, now, either of these panels G or I is connected to the radio frequency panel A instead of having twice as much hum, there will be no hum, because it will be found that the signal will be raised in strength in the radio frequency portion without distortion thereof, and the power frequency will be strained out in the transformer 8 and the signal detected in the detector, and other hum frequency kept out, whereby there will be heard in the output an undistorted signal without hum. This signal, however, will be relatively weak compared to what it would be if a powerful loud speaker were connected thereto. If, now, the loud speaker portion, C, of the model be operated separately, nothing will be heard but an amplified hum; but if this same portion C is connected to the detector portion, which, in turn, is connected to the radio frequency portion, there will be heard a clear, powerful, undistorted signal in the form of speech or music, and no hum will be heard. By this model, also, it can be demonstrated that if in place of transformer 8 there be substituted resistance capacity couplings, one

of which I have here, and mark "Plaintiffs' Exhibit 73", the hum frequency will be passed through, and the output will be a very large hum, which will distort the signal. Likewise, in this model, if the midpoint connections of the grid circuits are changed, such, for example, as a change in the radio frequency portion, the result will be that the signal will be distorted in the radio frequency portion, and such distortion can not be cured in any later portion of the instrument. And hum modulation will also be applied to the carrier frequency, which hum modulation can not be taken out in subsequent stages. Likewise, unless the grid of the radio frequency portion is conditioned by means of the resistance, capacity and resistance 29 of the patent, and its condenser, the tube of the radio frequency portion will not act as an amplifier, and will cause distortion of the signal and introduction of hum. All of these matters can be demonstrated by this model reproduction of the apparatus of the patent in suit.

Similarly, if the resistors of midpoint connections, 18, from the grids of the detector and audio frequency cathode tubes are not connected to the midpoint of the filament, a substantial 60-cycle or 120-cycle hum will be introduced at that point.

I have mentioned that one of these panels, panel I, has an indirect heated type of tube. This merely means that the cathode or tube is separated from but adjacent to the filament or heater whereby the alternating current is sent to the heater circuit and the heat thereof is communicated to the adjacent cathode and heats the same to cause the emission of electrodes upon the basis of which the operation of the tube depends. By this expression the same effect is attained as by connecting the grid of a direct-heated tube to the midpoint of the filament circuit. In this manner the tube is made to be as near like the crystal as is possible in that the crystal inherently does not create any hum itself and in the indirect heated cathode type of tube the tube does not inherent *by* create hum.

I have mentioned that if the grids of the radio frequency portion of the instrument is not connected to the midpoint of the filament, the cathode circuit likewise will be distorted. This will be because the voltage on the grid

will be such that the tube will not operate on the straight portion of its characteristic curve whereby the circuits of the incoming voltage will be greater in one direction than in the other.

I have before me diagrams attached to a stipulation marked "Plaintiffs' Exhibit 74", containing diagrams of models 104, 105, 106, 108 and 109 of certain Stewart-Warner broadcast receiving sets. I find that in all of these are present the same radio frequency portion, detector portion and audio portion; that in the radio frequency portion the signal is amplified and by means of midpoint connections or their equivalents the introduction of distortion and hum are avoided. In the radio frequency portion and detector portion precautions are taken to avoid or minimize the introduction of hum, and likewise in the audio frequency portion precautions are taken to minimize or avoid the introduction of hum; whereby the signal is progressively amplified to a strength far exceeding the strength of any hum introduced or transmitted, and precautions are taken to strain out and keep out hum frequencies.

In order to illustrate this I have colored on photostat reproductions of the drawings annexed to this Exhibit 75, the relevant circuits. The power unit circuits are colored purple, the grid circuits are colored green, the filament or cathode circuits are colored red, the plate circuits are colored yellow, and the loud-speaker output circuit is colored brown.

All these instruments, except the 108 type are of the type termed superheterodyne in which the first two tubes, for example tubes 57 and 56 in the type 104 and corresponding tubes in the other diagrams, are employed to change the carrier frequency from that at which it is received to a lower frequency termed the intermediate frequency. This intermediate frequency, however, is a very high frequency, of the order of 170,000 and odd cycles, which is far above audible frequency. It is, therefore, the full equivalent of the radio frequency portion of the Lowell and Dunmore Patent. These five colored photostats I mark "Plaintiffs' Exhibit 75."

The superheterodyne action is indicated simply in the simplified diagram which I produce, entitled Superhetero-

dyne Type of Radio Receiver, and which I mark Plaintiffs' Exhibit 76.

In this diagram the first tube is represented as receiving and delivering 1060 kilocycles to the input of the "Converter" tube. Another tube called the oscillator tube is delivering a still different frequency to the converter tube which may be 882.5 or 1237.5 kilocycles and reacts on the 1060 kilocycles to form a beat frequency of 177.5 kilocycles which is delivered to the "intermediate" frequency amplifier, which, as above stated, is well above the audible range and is a radio frequency amplifier.

Now, since the circuit of Plaintiffs' Exhibit 75 are prepared in the style frequently followed in the Engineering Departments of manufacturing concerns and show all of the circuits connected to ground instead of connected together as they are in reality, I have prepared and herewith introduce simplified diagrams which correspond with the diagram of Exhibit 75 but which are arranged in simplified form. In these simplified diagrams which I now introduce the same coloring as above mentioned is followed, namely, the rectifier circuits are colored purple, the input circuits are colored green, the filament and cathode circuits are colored red and the plate circuits are colored yellow; the output circuit of the loud-speaker is colored brown. These five simplified diagrams I mark as "Plaintiffs' Exhibit No. 77."

In these diagrams, as well as in the coloring of Exhibit 75 I have omitted the frequency conversion elements and have commenced with the so-called intermediate frequency tube which, as above stated, corresponds to the Lowell Dunmore radio frequency tube.

Referring to Model 104 of Exhibit 77 the radio frequency tube 58 is of the indirect heated type, thus corresponding to a tube in which the grid is connected to the midpoint of the cathode. Moreover, the cathode itself is connected directly to the midpoint of the heater circuit. The same is true of the grid circuit and cathode of the "Wunderlich" tube, which is the detector tube of the set. The audio frequency tube 47 is of the direct heated type. The radio frequency portion is connected to the detector portion by a radio frequency transformer 67976.

The heater circuits receive pure or so-called raw alternating current and rectified current from the rectifier is supplied to the plate circuits. The grid circuit of the audio frequency tube is connected directly to the midpoint of its filament, i. e. the cathode circuit being connected directly to the midpoint of speaker coil 67581, and thence through the yellow wire to the midpoint of the filament circuit; thus in its arrangement the signal is amplified in the radio frequency portion without distortion. Any hum frequency appearing in the circuit, such as in the plate circuits, is strained out when the signal passes through transformer 67976. Thereby there is delivered to the rectifier a robust signal, free of hum, and by reason of the indirect heated tube the introduction of hum is avoided in the detector circuit. In this case there is a resistance coupling between the detector tube and the audio frequency tube whereby the detected low frequency is transmitted to the input of the audio frequency tube and by means of the mid point connection the introduction of hum into the audio frequency portion is avoided. Thus the signal is progressively increased in strength, hum frequencies are strained out and kept out, as the signal passes through the set. What I have said about the model 104 also applies to the model 105. The same is true of the model 106, the only difference that I observe at the moment being that the tube of the audio frequency stage is an indirect heated type of tube instead of a direct heated type which, as before stated, is unimportant in that it is the full equivalent of the midpoint connection.

The model 108 is not a superheterodyne set, but the tube 39 is in the radio frequency portion. The tube 36 being the detector tube and the tube 38 the audio frequency portion. All of these tubes are indirect heated tubes, thus in effect connecting the grid to the midpoint or point of equal potential of the cathode. The signal strength is amplified in the radio frequency portion, the hum introduced thereby is strained out in the transformer 81666 between the radio frequency portion and the detector, hum frequencies are kept out of the detector and the audio frequency portion, whereby there is delivered at the output of the instrument a clear, undistorted signal of greater strength than any possible hum that may be introduced. What has been said of the other models applies to Model 109, all of the tubes of which

are indirect heated type tubes and the transformer 81758 is a radio frequency transformer, all of which acts to cause the instrument to operate as above described.

I have before me an instrument which I am informed is a Stewart-Warner model 109. This instrument is marked "Plaintiffs' Exhibit 78" and the table cabinet that contained it is marked Plaintiffs' Exhibit 82. I am prepared to demonstrate it in the presence of the Court and counsel to show that each stage taken separately will produce hum, but when the various portions are added together hum is eliminated and a clear signal obtained.

I can also demonstrate on this instrument that a substantial hum is delivered from the filter circuit to the plate circuits of the instrument.

I am prepared to demonstrate that by connecting a loud speaker outfit or telephone across the terminals of the rectifier and filter circuits as indicated in the diagram marked "Plaintiffs' Exhibit 79", a substantial hum will be heard, thus showing that the rectifier and filter portion of this instrument deliver to the receiving set a substantial hum.

I am also prepared to show by connecting a loud speaker or telephone instrument in series with the output circuit colored yellow in the diagram marked Plaintiffs' Exhibit 80, a substantial hum will be heard, whereas by connecting said loud-speaker or telephone in series with the input circuit of the detector, it will be found that this hum has disappeared, thus showing that the hum frequencies are strained out in passing through the radio frequency transformer.

Patent 1,635,117 relates to a method of operating the audio frequency amplified tube from household alternating current. In this patent the current is delivered at the mains, 28, to the transformer coil, 24. Two rectifiers are employed, one No. 13 and the other 14. The rectifier 14 furnishes rectified current to the plate circuit of the tubes 5 and 6. The rectifier 13 furnishes rectified current to the grid circuit of these tubes. In the grid circuit the resistance 18 is shunted by a condenser 19. The effect of this arrangement is to apply a voltage in excess of that developed by the signal energy which voltage is regulated

by the resistance 18, thereby making whatever drop may be desired to put the grids out of their potential, to cause the tube to operate in any manner desired. It can, for example, be supplied with sufficient negative potential to entirely stop the plate current. The so-called rectified current which is thus placed upon the grid circuit is not at all the steady direct current which is derived from a battery, but, on the contrary, is a pulsating current, which although the pulses are in the same direction the voltage rises and falls in the same manner as in a true alternating current. This fluctuating voltage would cause the grid voltage to fluctuate in a like manner and thus destroy the operation of the tube but for the means employed by the patentee, to wit, the resistance shunted by the condenser, which causes this fluctuating energy delivered by the rectifier to apply a regulated steady potential upon the grid, the fluctuations being smoothed out by the condenser 19.

In all of these Stewart-Warner sets above referred to the same means are employed. I produce a diagram, Plaintiffs' Exhibit 81, in which I have shown in further simplified form the rectifier and tube circuits of the audio frequency tube in each of these models. Referring to the model 104, for example, it will be seen that the output terminals of the rectifier are connected across the plate circuit and lead, for example, from the minus side through the coil 67581 to the cathode, thence to the plate and thence to the positive side of the rectifier. The grid circuit leads through the resistance 67260, shunted by the condenser 67517, through a portion of the speaker coil 67581 to the cathode. A portion of the speaker coil is common to both circuits and at this point energy is fed from the rectifier to the grid circuit, the resistance 67260 shunted by the condenser 67517, acts to impart the desired grid voltage to the grid and the condenser 67517 operates to smooth out the fluctuations of this voltage and thereby impart a steady desired voltage to the grid.

In the model 106, the plate circuit is from the minus side of the rectifier through the resistance 220 to the cathode, thence to the plate and back to the positive side of the rectifier. The grid circuit is from the negative side of the rectifier through the resistance 81530 to the cathode, thence to the grid, thence through resistance 81382,

which is shunted by condensers G-81580, and thence back to the negative side of the rectifier, the positive side of the rectifier being connected at the opposite side of resistance 220. Thus the rectifier supplies potential to the grid circuit by resistance shunted by a condenser and these operate to apply a steady voltage to the grid and smooth out all fluctuations.

In like manner in models 108 and 109, as shown by the diagram, the rectifier supplies voltage to resistance 81683 in model 108 and 81725 in model 109, these resistances being common to grid and plate circuits. And in both cases there is a resistance shunted by a condenser which operates to smooth out these voltages.

While it is true theoretically that by employing a large number of coils and a large number of condensers in the power circuit, the energy could be smoothed out to a point where the hum would be unobjectionable, to do this would be expensive, and manufacturers do not manufacture filters to such a degree of perfection. In the Stewart-Warner set, as I am prepared to show, on the 109 speaker, which is Plaintiffs' Exhibit 78, the output from the rectifier and filter unit is fluctuating to a substantial degree, whereby there is delivered to the grid circuit of this receiver a substantial hum producing voltage which, but for the circuit employed including the resistance shunted by the condenser would make the voltage on the grid fluctuating to such an extent that the tube would be useless in operation.

PERCIVAL D. LOWELL. Referring to Exhibit 78, this is the chassis and electrodynamic loud speaker unit of the Stewart-Warner 109 model. I received this model mounted in the table type cabinet, which I offer in evidence as Exhibit 82. I removed the chassis of the model 109 from cabinet Exhibit 82 and mounted the chassis on a frame structure hinged to a base so that I might readily move the hinge frame back to view the connections beneath the chassis. I then traced the wiring in the Stewart-Warner 109 and located the tube circuit of the intermediate frequency amplifier. At a point in the output circuit adjacent the plus B connection to the primary winding of the intermediate frequency transformer, I cut the conductor and inserted between the ends of the cut conductor .00025 MFD condenser. I brought out leads

by soldering the leads on opposite sides of the connection to the condenser through a flexible shielded conduit grounded to the chassis, which conduit I ran to a position adjacent a 4-pole double throw switch on the side which I have marked Primary. I then located the input circuit of the detector and at a point in the input circuit remote from the connection of the transformer secondary to the diode second detector tube I cut the conductor and inserted a condenser of .00025 MFD. In order to distinguish the second condenser from the first condenser, I have shown the second condenser in green in Exhibit 80 as part of the input circuit to the detector. The first condenser I have illustrated in yellow. I soldered connections to opposite sides of the condenser in the input circuit and carried these leads through a flexibleshield to the opposite side of the 4-pole double-throw switch to the side I have marked Secondary. Two of the knife portions of the 4-pole double-throw switch were connected through another testing switch, which testing switch has its knife members connected to terminals which may be connected either to a telephone head set or a test amplifier and speaker unit. The 4-pole double-throw switch may be moved to effectively connect the test telephones or test apparatus to a position in the output circuit of the last stage of the intermediate frequency amplifier in series with the primary winding of the radio frequency transformer, in which position the condenser which I inserted in the secondary circuit is shunted by the third blade of the 4-pole double-throw switch, whereby the test apparatus given an observation of the quantity of hum in the output circuit. In testing the Stewart-Warner model 109, I find considerable hum in the output circuit of the intermediate frequency amplifier. However, by transferring the connections between the testing apparatus and the input circuit (green) of the detector which is on the secondary side of the radio frequency transformer, by moving the 4-pole double-throw switch to the side marked "Secondary", the testing apparatus shows a very substantial reduction in the hum, clearly establishing the straining-out function of the radio frequency transformer. In this latter position the fourth blade of the 4-pole double-throw switch serves to shunt the condenser in circuit with the primary winding (yellow) of the radio frequency transformer. The testing apparatus

therefore provides means for observing the relative quantity of hum on the primary and secondary side of the radio frequency coupling transformer. The difference between this hum is very apparent. That is the hum on the primary side is of very substantial amplitude, whereas the hum on the secondary side is of negligible amplitude.

In order that the Stewart-Warner Model 109 may function in its normal state, I provide a double throw single pole switch which when closed shorts out both of the fixed condensers inserted in the output and the input circuits (yellow and green), thereby providing continual circuits in the same manner as originally included in the Stewart-Warner circuit. The leads extending outside of the chassis are thoroughly shielded. In order to determine the quantity of hum delivered by the main filter, I provided connections from the main filter to fixed terminals of the double pole double-throw testing switch connected in accordance with Exhibit 79. These connections were made employing wires, one conductor and the shield already brought out for the test circuit of Exhibit 80. This enabled me to throw the double-throw double-pole switch to a position in which the knife members were connected to the fixed terminals connected to the output of the main filter through a condenser for preventing the passage of direct current into the testing apparatus, which condenser, however, allows the hum fluctuations which are superimposed upon the direct current to pass through to the test ap-aratus.

As before stated, the test apparatus, either in the form of telephones or a power speaker, is connected to the knife members of the double-pole double-throw switch. When connecting the main filter to the testing apparatus, I observed a loud hum from the testing apparatus, showing the imperfect filtering of the alternating current supplied to the circuits of the Stewart-Warner Model 109 and the failure of the main filter to suppress alternating hum at the source. In order to prevent any leakage of hum into the testing apparatus a shield is provided between the input of the testing apparatus and the terminals just described.

PERCIVAL D. LOWELL, would testify as follows:

I was a laboratory assistant at the Bureau of Standards and met my co-inventor Dunmore in 1918. I was working with Dunmore in September, 1921, and conceived the joint invention with Dunmore which resulted in Patent 1,455,141 on or about September 28, 1921. I had an accident from storage battery burns while engaged in work in the radio laboratory and was generally dissatisfied with the disadvantages of storage and other batteries for operating radio receivers. I conferred from time to time with my co-inventor Dunmore and jointly worked out the receiving circuit of Patent 1,455,141.

I worked with Mr. Dunmore on the apparatus embodying the circuits on page 41 of Dunmore's notebook, Exhibit 14 on October 7, 1921, and in the development of the recorder shown in the photograph Exhibit 15 and on the actual apparatus, which is still on file in the Interference Division of the United States Patent Office, and on the bread board set-ups which resulted in the December 8-10, 1921 reduction to practice, shown in Dunmore's notebook, pages 524 and 525 of the Radio Appeal record. I depended on Dunmore to keep the records of our joint work, but I made out some monthly reports and some time cards, and commencing in January, 1922, I kept a notebook, which I offer in evidence as Exhibit 83, pages 596-671, of the Appeal Record. In my monthly report, dated December 15, 1921 to January 15, 1922, which is part of Exhibit 83, page 621, Radio Appeal record, I mentioned some of my work with Mr. Dunmore in connection with the alternating current operation of radio receiving apparatus. In my time cards for 1922, I made an entry under date of January 10, 1922, respecting the further investigations of the alternating current operation of radio receiving apparatus. This further investigation was made as a result of a request by Dr. Dellinger who wished to acquaint himself with some of the work we had done. I wrote a memorandum on January 9, 1922 in which I told Dr. Dellinger that some amplifier work using alternating current had been begun. Dr. Dellinger wrote across this memorandum, "First outline which requires amplifying" and requested me to write a further memorandum. This I did on January 21, 1922, in which I outlined to Dr. Dellinger some of the work which Mr. Dun-

more and I had been carrying on with respect to the energizing the circuits of multi stage amplifiers from alternating current. Dunmore and I continued the testing of various circuits using alternating current for filament and plate supply voltage for electron tube receivers and I kept further notations in a notebook, Exhibit 83 shown at pages 631-671, Radio Appeal Record.

Dunmore and I were busily engaged in the investigation of the alternating current operated radio receiver through January-March, 1922, as will be observed by the notations in my notebook, Exhibit 83, on pages 631-671, Radio Appeal Record. On page 42, Radio Appeal Record page 642, there appears a complete diagram of an alternating current operated radio receiver which Dunmore and I tried January 20, 1922. Checking back with Mr. Dunmore's notebook, Exhibit 14, it is found that on the same date of January 20, 1922, there appears a similar diagram on page 57 of Mr. Dunmore's notebook, Appeal Record page 530, this diagram bearing the notation "Complete A. C. receiver including loud-speaker, January 20 '22", "By F. W. Dunmore, January 20 '22 and P. D. Lowell, January 20 '22."

Mr. Dunmore personally made the Patent Office drawings which were filed in the Application in his apartment at 2371 Champlain Street, Northwest, Washington, D. C. At the time we filed this application, we were both hard put for funds and did not feel that we could pay for having the drawings made. Mr. Dunmore had just been married and his wife's father was dependent upon him for support. During 1921 and the first half of 1922 I worked at night in the Arcade Bowling Alleys in an effort to better my financial condition as I had been married but a short time and had a wife and baby to support. In my spare moments at night at the Arcade Bowling Alleys when I was not actually busy with the Bowling Alleys, I spent considerable time thinking about, working out circuits for and writing descriptions of the work which Dunmore and I were doing on alternating current power supply. It was at the Arcade Bowling Alleys that I wrote out a description about the middle of January, 1922, which I now offer in evidence as Exhibit 84, which description I gave to our attorney for preparation of the Application for Patent. Dunmore visited me at the Arcade Bowling Alleys at night to consult with me about the

alternating current operated radio receiver. However, under Civil Service rules then in effect, it was not possible for me to secure a raise in salary. Our application for patent was not filed until March 27, 1922. As I was financially unable to pay my part of it, Mr. Dunmore paid this in full by check and I reimbursed him later on. The check dated March 25, 1922, is offered in evidence as Exhibit 87. One-half of the attorney's fee for preparing and filing the application was paid by check by Mr. Dunmore, dated June 29, 1922, and I paid my half in cash for I had no checking account. Mr. Dunmore's check is offered as Exhibit 87. If we had had proper means available our application for patent would have been filed much earlier than the filing date of March 27, 1922.

At the end of my monthly report for January 15-February 15, 1922, Appeal Record page 624, I mentioned that shop drawings had been made up for two units, that is, the five stage amplifier unit and the rectifier unit. Mr. Buckley made the shop drawings under the direction of Dunmore and me. The amplifier and rectifier units were made up in the final form shown in Exhibits 19 and 20, and as shown in Photograph Exhibit 17. I traced the connection of the apparatus constituting Exhibits 19 and 20, which diagram is now Exhibit 18.

It will be observed that the apparatus of Exhibits 19 and 20 comprises three stages of electron tube radio frequency amplification, the crystal detector and two stages of audio frequency amplification. The rectifier unit Exhibit 20 supplies raw alternating current to the cathode circuits and rectified alternating current to the plates, and there are a multiplicity of means in the circuits for eliminating hum of the alternating current in the apparatus.

I demonstrated this apparatus on numerous occasions to visitors at the Bureau of Standards Laboratory. I wrote the article which was published as the Bureau of Standards scientific paper No. 450, entitled "An Electron Tube Amplifier using 60-cycle alternating current to supply power for the filaments and plates," Exhibit 8 on page 63 of the Appeal Record, Vol. 3. In this paper I mention that F. W. Dunmore was a co-worker and participated in the development of this instrument. The photograph of the amplifier and rectifier unit illustrates the apparatus as completed by Dunmore and myself in

the early part of March, 1922. I offer this photograph in evidence as Exhibit 85, completed Bureau of Standards A. C. operated set. (Photographs of Exhibits 19 and 20.)

I received numerous requests for information respecting the construction of alternating current operated radio receivers, and in the article appearing in the Electric Journal for December, 1922, page 501, which I offer in evidence as Exhibit 55 (Appeal Record, page 205), Vol. 2, and H. M. Freeman of the Westinghouse Electrical Manufacturing Company refers on page 505 of his article to the article published in the Journal of the American Institute of Electrical Engineers for July 1922, which described the work of Mr. Dunmore and myself on the elimination of batteries in radio receivers.

This Journal is published by the Westinghouse Club, Pittsburgh, Pa. I noted that Westinghouse Electrical Manufacturing Company announced the invention of the alternating current operated radio receiver almost in the very beginning, as shown in a paper published in Pittsburgh under date of June 6, 1923, the article from which I offer in evidence as Exhibit 86.

I collaborated with Mr. Dunmore in the construction of alternating current operated radio receiving sets, Exhibits 24 and 25, the box type of radio receiving set, Exhibit 26, and the Freed-Eiseman neutrodyne alternating current operated set, Exhibits 27 and 28.

I identify the circuit diagram Plaintiffs' Exhibit 50, page 187, Vol. 3, Appeal Record, as the Circuit diagram of the box type set of Exhibit 26.

Mr. Lowell, Mr. Dunmore and myself worked out the manner of including the coupling elements between the stages of electron tubes in the radio frequency amplifier for preventing the transfer of alternating current hum from stage to stage in the receiving apparatus.

I disclosed the box type set to Dr. Louis M. Hull of the Radio Frequency Laboratories, Inc., of Newark, New Jersey, in the early spring of 1924.

I subsequently embodied the circuits of Mr. Dunmore and myself in commercial receivers which I designed for A. H. Grebe & Company, Inc., which were widely sold and successfully operated.

Plaintiff offers the stipulation dated June 5, 1934, entered into by counsel for the respective parties, relating to certain Stewart & Warner sets.

Plaintiff offers to prove that the instrument marked Plaintiff's Exhibit 78 was sold by the defendant, and that when received the circuits were in the condition testified by witness Lowell.

In accordance with the oral agreement between counsel, plaintiff offers the following exhibits, which now appear in Radio Corporation Appeal Record above referred to, namely, the plaintiffs' Exibits 1, 2, 3, 4, 5 and 6.

The deposition of George H. Lewis, appearing on pages 138 to 148 of said record.

The deposition of John B. Brady, appearing on pages 148 to 178 of said record.

Also plaintiffs' Exhibits 8 to 13-F and 46, 47, 48, 49 and 49-A, in said case.

Also the deposition of Roy E. Sweeney, pages 178 to 182, and Joseph D. R. Freed, pages 183 to 190.

Also the statement of counsel appearing on pages 270 and 273 of Vol. 1 of said Radio Corporation Appeal Record.

Also Plaintiffs' Exhibits 50, 51, 52, 52-A, 53, 54, 55, 56, 57, 58 and 59 in said record.

Also the deposition of Alexander E. Reoch, appearing in Vol. 1, pages 275 and 285 of said Record, and the Defendants' Exhibits 11, 12 and 13, referred to in said deposition.

Also the deposition of John H. Dellinger, appearing in said Appeal Record, and also pages 290 to 295, inclusive, 297 and 305 to 311, inclusive, of the deposition of John H. Dellinger in said Radio Corporation Appeal Record, and the Defendants' Exhibits 1 and 7, referred to in said Dellinger deposition.

Plaintiffs also offer to prove that none of the prior art patents, publications or devices offered in evidence in the aforesaid Radio Corporation Appeal Record discloses a radio receiving apparatus adapted to be operated from an alternating current source without emitting hum from said alternating current source; that none of said

prior art references discloses a radio amplifier powered by alternating current and followed by a detector and hum eliminating means effective to permit the operation of said device without developing and producing objectionable hum; that none of said prior art devices discloses the aforesaid combination and an audio amplifier, the whole adapted to be operated by alternating current and having hum-eliminating means permitting the operation of such combination without objectionable hum from the power source; that none of such prior art references disclosed the idea of amplifying the signal strength and straining-out and keeping out low frequency hum; that neither the White patent nor the Heising patent mentioned in the opinion of the Circuit Court of Appeals for the Third Circuit discloses a receiver with a radio frequency amplifier and a detector operated from an alternating current source without hum from the power source, and neither discloses any hum eliminating means which, if repeated in a continued radio frequency unit and a detector unit operated by alternating current would be effective to avoid hum from the power source in the output of such combination and neither discloses nor suggests the use of an audio frequency amplifier in such a combination, nor the idea of increasing signal strength beyond hum strength and straining out and keeping out hum frequencies. Nor does any such reference disclose separate hum-eliminating means in the radio amplifier and detector portions of the instrument, nor in the radio amplifier, detector and audio amplifier portions of the instrument.

Plaintiffs further offer to prove with respect to said Dunmore Patent 1,635,117, that none of the prior art patents or publications or devices referred to in the Opinion of the said Circuit Court of Appeals for the Third Circuit in said Radio Corporation case discloses a means for applying alternating or rectified potential to an amplifier tube and operated the same without power frequency hum and signal distortion; that none of such references discloses the application of alternating or rectified potential to the grid circuit of the tube to apply an electric potential to the grid; that none of said references discloses an alternating or rectified potential to the grid circuit of an amplifier tube and interposing in the grid circuit a resistance shunted by a condenser.

ORAL OPINION OF COURT.

Rendered 18 June, 1934.

IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MARYLAND.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs,

vs.

A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, Defendants.

Equity No. 2193.

Baltimore, Maryland, June 18, 1934.

OPINION (ORAL).

COLEMAN, District Judge:

I feel, after the extensive argument; after having had the benefit of the analysis of the various authorities that have been cited, and after a careful reading of the decisions of the courts of the Third Circuit bearing upon these same facts, that the Bill must be dismissed as to the two patents, No. 1,455,141 to Lowell and Dunmore, and No. 1,635,117 to Dunmore, both relating to radio receiving apparatus, primarily for the reason that I am unable to conclude that proper disclaimers have been made with respect to claims 3 and 14 under the first patent, and claim No. 9 under the second patent, as I interpret the requirements of Sections 65 and 71 of Article 35 of the United States Code governing disclaimers. In other words, without going into my reasons at length, I believe the argument advanced by counsel for defendants represents substantially a correct statement of the law in a situation of this kind in regard to disclaimers. I am not prepared, therefore, to accept the argument advanced by counsel for plaintiffs, which is, in effect, that I need not require disclaimers at this time, or, at least, that the disclaimers, which seem to me not to disclaim

at all, may nevertheless, be disregarded for the purposes of this new suit, and that I should proceed to hear the matter on the merits.

I rest my conclusion primarily upon that ground, although I think there is a very persuasive argument producing the same result, to the effect that where a court is prima facie satisfied that the matter has been correctly decided, as a result of litigation in another circuit, where the matter has been thoroughly thrashed out, and the highest court of that circuit has rendered its decision, and the Supreme Court has refused certiorari, that should be binding upon this Court. It is not absolutely binding, of course, if this Court feels that there is some obvious error which ought to be corrected. But I do not believe that the rule in a case of this kind, the rule of comity, requires another trial, and that the District Judge shall wade through what would be the same testimony, perhaps put up in a little different way,—old wine in new bottles,—and perhaps some additional testimony, just for the purpose of permitting one party to find out whether the new trial judge may not be persuaded to reach a different conclusion on matters of the most technical sort, which that same judge must assume have been given the most careful consideration by the two Courts in the other circuit, and also by the Supreme Court itself at least to the extent that the examination of the Petition for Writ of Certiorari requires.

If a different rule is adhered to, it seems to me that patent litigation becomes endless; that it encourages a race around the country, almost, in trying to find out whether one circuit won't upset another. There are exceptions to all rules, of course, and it is perfectly obvious that my decision is somewhat influenced by the complexity of the case,—largely influenced. But it seems to me that that factor weighs in both directions. The very fact that the matter is so complex requires a new court, a court looking at it for the first time, to assume, in the absence of evidence to the contrary, that the other courts have given it all the care that that complexity requires.

The following from the opinion of the Circuit Court of Appeals, Third Circuit, dealing with claims 3 and 14 of Patent No. 1,455,441, (Radio Corporation vs. Dubilier Corporation, 59 Fed. (2) 305-308), clearly shows what that

Court decided, and the reasons for its decision: "The invention is directed particularly to the elimination of hum occurring in the vacuum tubes when they are heated by unrectified alternating current.

"• • • • • Lowell and Dunmore thought this expense could be reduced substantially by using common house lighting current. It was cheaper than current from batteries, but to employ it as a source of electrical energy they were confronted by two obstinate facts: One, house current is alternating current of about 110 volts and has a frequency of about 60-cycles a second; the other, these rapid and continued reversals of direction produce in a sound output receiving set a distortion of the modulation and a strong hum that makes the reception unsatisfactory. Believing they had overcome these difficulties, Lowell and Dunmore invented the apparatus of the patent in suit, operated by home alternating current instead of by direct battery current, and disclosed its elements and their functions by many claims. Claim 3 is typical.

"• • • • • If they had invented this apparatus and all its elements, their invention unquestionably would have been basic; it would have been more than that; it would have been stupendous, for it would have covered the major portion of the practical radio art as it stands today. But they did not invent all of these elements; indeed, they frankly admit they did not. What, then, is the invention?

"• • • • • Therefore, in the final analysis, the claimed invention consists in applying curbed alternating current to the detector section and the audio frequency amplifier section and also to the radio frequency amplifier section in the same way that it had previously been applied to the last-named section. Is this invention?

"• • • • • It follows that the effect of the operation of all these eliminators is an aggregation of separate results, Powers-Kennedy Corp. v. Concrete Co., 282 U. S. 175, 186, 51 S. Ct. 95, 75 L. Ed. 278, all alike and all admittedly obtained by prior art means. From the very nature of the circuit connections the three eleminators act independently of one another, Hailes v. Van Worner, 22 Wall. (89 U. S.) 353, 22 L. Ed. 241. Operating separately yet in conjunction with other elements of the

combination they evolve no new cooperative function, Grinnell Washing Machine Co. v. Johnson Co., 247 U. S. 426, 433, 38 S. Ct. 547, 62 L. Ed. 1196; Office Specialty Mfg. Co. v. Fenton Metallic Mfg. Co., 174 U. S. 492, 498, 19 S. Ct. 641, 43 L. Ed. 1058, and the new result, as claimed, is only that which arises from the well-known operation of each one of these several elements of the combination, Grinnell Washing Machine Co. v. Johnson Co., supra.

"Having before them White and Heising, who told them how to prevent hum in vacuum tubes energized by alternating current wherever positioned in the receiving set, we can not believe it was invention for Lowell and Dunmore to connect a hum eliminator with the audio frequency amplifier tubes even if they were first to do so, or invention to connect them separately with the radio frequency amplifier tubes (as before), with the detector tubes and the audio frequency amplifier tubes.

"* * * * * Being of opinion that in developing the apparatus of the patent in suit the patentees applied in a natural and ordinary way the prior knowledge of the art without making an inventive advance, we are constrained to hold claims 3 and 14 of the patent invalid."

The following taken from the same Court's decision with respect to claim 9 of Patent No. 1,635,117, discloses sufficiently for the purposes of the present case, what the Court found and decided (Radio Corporation vs. Dubilier Corporation, 59 Fed. (2) 309, 312): "The invention, as the plaintiffs state in a few words, consists of means for imparting positive potential to the plate and negative potential to the grid electrodes of a vacuum tube by low frequency alternating current. They say this was new and very useful and therefore amounted to invention, and that Dunmore was the first in the art to conceive and apply it.

"* * * * * But Dunmore says he did more than (b) substitute electric power of one kind for electric power of another kind, defined by their respective sources, in that he (c) rectified or converted the substituted ineffective alternating current into workable direct current. This certainly he did, and if he were the first to do it, or if he did it in a new way it might be invention.

"* * * * Hull's invention was a tool of the art. With this and other tools of the art in his hands, we can not find that Dunmore made an invention when he applied them to an audio frequency amplifier tube effecting grid bias."

There is the additional point, namely, laches, which, however, I do not think is particularly strong in this case. In other words, I would not, on that ground alone, grant the motion, because I think that the defense of laches raises such a highly discretionary question it should be allowed to prevail only in extreme cases. In view of the mass of patent litigation that has surrounded these patents, it is at least open to very serious question whether it would be reasonable to say that a lapse of eight months and thirteen days, after the denial of the petition for Writ of Certiorari, was in and of itself sufficient to warrant this court in saying that the requirement of due diligence under the statute was not met. Thus we have a combination of circumstances which seem to me to be adverse to the plaintiffs' contentions.

The only patent that remains to be considered is No. 1,606,212, granted November 9, 1926, to Dunmore and Lowell, on an application filed March 21, 1922, and it relates to an amplifying unit and reproducer of electrical signals. All claims from 1 to 9, inclusive, are here in suit.

The plaintiffs charge that the defendants' device infringes the device of this patent, and defendants assert the usual defenses of invalidity and non-infringement.

Taking up first the question of validity, with respect to which the burden rests upon those raising it, namely, upon the defendants, I do not find that this burden has been met by the defendants; that is to say, I believe on the proof submitted that the evidence is not sufficient to warrant my saying that the patent is an invalid one for any of the reasons advanced.

I believe it is the reasonable inference from Judge Morris' statements in his opinion, in which he thoroughly considered this same patent in relation to another alleged infringement, in the case of Dubilier Condenser Corporation against the Radio Corporation of America, 34 Fed. 2nd, 450, (from which there was no appeal with respect to this patent), that he did not think the amendments invalidated the patent. It is true he did not finally decide

this question; and, therefore, his decision is not to be taken as final on this question; nor, of course, is it binding upon this Court; but I believe that is a reasonable inference, and I believe that it is a sound inference, supported by the proof in the present case and by the statements contained in the specifications, as disclosed in the patent, without making an examination of the file wrapper and history of this patent in the Patent Office. At least, I would not want to rest my decision upon such doubtful ground.

Turning to the next phase of the invalidity question, that is, whether the patent in suit has been invalidated by reason of prior patents, suffice it to say that the only patent which I understand is seriously urged by the defendants on this point, namely, that to Pridham and Jensen, No. 1,105,924, issued August 4, 1914, does not deal with alternating, but with direct current, and I am satisfied that that is a sufficient distinction, realizing, of course, that in the present case, one of the basic features is that the alternating current is rectified and turned into direct current. But I think the distinction is a substantial one in the art; and I venture to say that Judge Morris had the same view, although, again, as he clearly states, he did not feel called upon actually to decide this question.

Coming then to the question of infringement, with respect to which the burden rests upon the plaintiffs, on all of the credible evidence I reach the conclusion that infringement has been proven. Here, again, I rely to some extent upon the help afforded by Judge Morris, by the very clear analyses which he gives in his opinion of this patent in relation to the alleged infringing device, which he at that time had under consideration.

The question is a highly technical one, and different tests in cases of this kind are bound to produce varying results. I adopt the conclusion of Judge Morris that as a consequence of the amendments, the claims here in suit are to be held to include and to be limited by the interaction or cooperation disclosed in the amendments, and I believe that certain passages from Judge Morris' opinion set forth very clearly the object sought to be obtained by the plaintiffs' device,—the device under the patent here in suit.

Judge Morris said (pages 459-461): "The unit includes a plurality of thermionic vacuum tubes connected in circuit for audio frequency amplification and a loud speaker employing a coil armature and an electromagnetic field coil. The unit was old; but it had been operated only with direct current. The patentees' aim was to obtain faithful, humless reproduction from alternating current operation. Their means for accomplishing this result are set out in claim 2 thus:

"'2. In an apparatus for the reproduction of sound, a thermionic vacuum tube amplifier, an input circuit, an output circuit, a power source of alternating current, means for rectifying said current, a loud speaker reproducer connected in said output circuit and comprising an armature winding and a field winding and circuits for supplying said rectified current to said output circuit and to said field winding, said windings being connected in such relation that disturbing current effects in said loud speaker reproducer are substantially eliminated.'

"The function of the loud speaker is, of course, to convert the audio frequency pulsations of the output electrical current of the amplifier into sound vibrations. To produce this result, means must be employed to enable the pulsations to actuate a diaphragm. A telephone receiver, which functions in this manner and for this purpose, consists of a hard rubber case inclosing a U-shaped permanent magnet of hard steel, to the free ends of which are clamped two soft iron pole pieces, each wound with a coil of small-diameter insulated copper wire in the talking or output current circuit. A hard rubber cap or earpiece, with an opening at its center, supports a soft, sheet-iron diaphragm in front of the pole pieces. As the pulsating current flows through the coils on the soft iron poles, it sets up a magnetic field, which either strengthens the constant magnetic field of the permanent magnet, and so draws the diaphragm a little closer to the poles, or weakens that field by opposing it, and hence allows the diaphragm, which is always under strain of attraction from the permanent magnet, to spring away from the poles. Between pulsations the magnetic field returns to its normal strength, and the diaphragm immediately returns to its original and normal position. Thus the diaphragm vibrates with the pulsations of the cur-

rent, and reproduces the sound vibrations which at the transmitting station caused the current pulsations. This device employs both the permanent magnet of hardened steel and the electromagnet of soft iron pole pieces, which is magnetized only when electricity flows through the coils and loses its magnetism when the flow ceases.

"In the loud speaker of the patent there is no permanent magnet. An electromagnet, only, is made use of. This is in the field coil, 10. Again, the armature is not the loud speaker diaphragm, but is an 'armature coil', 9, in the output circuit of the vacuum tube amplifier, movably supported and connected to the diaphragm. It is so positioned that it is, likewise, within the magnetic field of the electromagnet. As current electricity always produces a magnetic field, and as the pulsating current of the amplifier output circuit passes through the armature coil, an electromagnetic field is also set up by that coil. The fluctuations of that field correspond with the pulsations of the current by which that field is produced. These fluctuations, acting in conjunction with and in opposition to the field or pull of the electromagnet, impart vibrations to the armature coil, and so to the connected diaphragm, proportionate to the current pulsations in the amplifier output circuit. The audio frequency vibrations of the current are thus converted into sound.

"Since the sound output of the loud speaker is the joint product of the two magnetic fields, it is obvious that for accurate reproduction of the transmitted tones the only audio frequency fluctuations in either of those fields that may be permitted to take part in imparting vibrations to the armature coil, and through it to the diaphragm, are those produced by the transmitted-tone variations in the current flowing through the armature coil. So to restrict the magnetic fluctuations in the joint field, when both the amplifier and the loud speaker are powered by 60-cycle alternating current from residence lighting circuits, was, in reality, the problem to the solution of which the patentees addressed themselves. They were the first, so far as the record discloses, to set themselves to this task. Until about 1918, the ordinary telephone receiver was employed. Then the permanent magnet type of receiver, having a weak, but constant, field, ap-

peared. About 1920, the Magnavox, in which the output circuit from the receiving set passed through an armature coil suspended in the field of an electromagnet, the coil of which was energized by a battery, made its appearance. Its power requirements were such that it fell into disuse. Instead of attempting to supply the necessary power, the art directed its efforts to the improvement of the permanent magnet type of loud speaker.

"Lowell and Dunmore, however, went in the opposite direction. They turned to the house-lighting, alternating current for power, and employed means to overcome its 60-cycle, hum-frequency effects in the joint field. In the amplifier the means employed consist of a rectifier, a filter, or condenser, and inductance coil to minimize the pulsations in the rectified current, the old, variable, potentiometer connections in the grid-filament circuit, and a separate, armature-coil circuit. In the field circuit, wherein, also, current variations or pulsations would produce corresponding fluctuations in the magnetic field, the patentees utilize a half-wave rectifier, and the field coil itself to remove, neutralize, or reduce, through its inductance and 'skin effect', the pulsations and hum-frequency variations in the current. In addition the patentees pointed out by amendment of March 27, 1926, that pulsations in the field winding and in the armature circuit are opposite in phase, and that there is a consequent tendency for the disturbing pulsations to offset and neutralize each other.

"Defendant contends that the amendment was and is invalid, in that it contains new matter and was made about six months after defendant's loud speaker went on the market. It further contends that the claims are based on the amendment, and that they, too, must fall, not only for want of a proper foundation in the specification, but also because of anticipation by Pridham and Jensen's patent No. 1,105,924, issued in 1914, and because, if they are not limited by phase opposition, they are merely for an amplifier, old per se, aggregated with the old Magnavox loud speaker. Defendant likewise urges that its loud speaker is not within the scope of the claims when properly construed.

"Plaintiffs take the position that the amendment did not introduce new matter in any invalidating sense, in

that, as they assert, the amendment was in effect but an explanation of the theory upon which the device operated or functioned in part. They further contend that the claims in issue, even if construed to include phase opposition, are not anticipated by the Pridham and Jensen patent; that, since other claims not in issue are specific to phase opposition, the claims in issue should not be so construed to be limited by phase opposition, but that, howsoever construed, defendant's loud speaker comes within them."

* * * *

"Regardless of the fact that Dunmore and Lowell were the first to obtain a reasonably satisfactory reproduction of transmitted sounds from an amplifier loud speaker unit energized by alternating current, it is of course, beyond dispute that the claims can not be given a construction broad enough to confer upon the patentees a right to the exclusive use of alternating current for producing their result. O'Reilly v. Morse, 15 How. 62, 14 L. Ed. 601. Consequently, interpretation requires that the means of their disclosure be resorted to. Separately considered, both the amplifier and the loud speaker were old. 'Skin effect', and impedance, which includes reactance and resistance, were known inevitable consequence of the energization of field coils of the Magnavox type by pulsating current: In view of the lack of novelty in the amplifier and in the loud speaker, separately considered, and of its failure to find any co-operative effect set out in the specification, the Patent Office rejected all claims. Thereafter the patentees amended by adding the matter now appearing in lines 65 to 79 of page 2 and in lines 24 to 33 of page 3 of the patent. All claims were likewise amended. As a consequence of these facts and actions, all claims must be held to include and be limited by the interaction or co-operation disclosed in the amendments. * * * *."

An analysis of the alleged infringing device in the Delaware case, which was held by Judge Morris not to infringe, helps us to understand the defendants' device in the present case, and assists in a proper determination of whether defendants' device in the present case does infringe. Judge Morris says (page 461), speaking of the alleged infringing device in that case, that it "is designed to eliminate from the amplifier circuit and from

the field coil circuit any and all hum producing fluctuations there present, and to leave no residual fluctuations to be neutralized by cooperation between the amplifier and loud speaker. The means used by defendant to make its field coil current steady and pulsationless, and to shield its armature coil from the effect of residual fluctuations or magnet leakage, include, in addition to the impedance and skin effects of the coil itself, a full wave rectifier instead of the half wave rectifier of the patent, a filter to smooth out the ripples in the rectified current, a pot magnet, the placing of the armature coil in as non-inductive relation as possible to the field, and copper rings to shield the armature coil from the effects of any surviving current pulsations."

In the present case the testimony satisfies me that the defendants' device has all of those elements, except the copper rings referred to.

Judge Morris then goes on to say (page 461): "Defendant's mode of operation is the direct antithesis of that of the device of the patent, which intentionally employs neutralization by direct phase opposition. • • • • The phase opposition of the patent is direct, not echoed."

It seems to me to follow as a necessary corollary of what Judge Morris has said, that if the device of the defendant in the case before him, had had direct phase opposition, the situation would have been entirely different. I believe that that different situation is the one which is, in fact, presented here. The fact that the hum is very largely, if not entirely, eliminated in defendants' device in the present case by the filter before it gets to the loud speaker, seems to me not to be a sufficient answer to the charge of infringement, as long as there is direct phase opposition in the coils of the defendants' device. The evidence discloses that to be true, and the conclusion therefore seems to me to be inescapable that since, as I find, plaintiffs' patent discloses a novelty in the form of direct phase opposition, because this was not disclosed prior to the date of the issuance of the patent, and not anticipated by prior patents or by prior use, it is infringed by any similar device which uses its coils in phase opposition.

I think there is much weight to the argument advanced by plaintiffs that the question of elimination in the re-

ceiving set is a question of the character of the filters. It is true that one of the devices put in evidence by the defendants,—one of its own devices,—disclosed virtually the same hum, regardless of the adjustment of the current in the coils. The other device of defendants produced quite different results, and showed that the noise, the hum, was more nearly comparable to that created in plaintiffs' device, when the coils were placed in phase opposition than when they were not placed in phase opposition.

Summarizing my conclusions, the charge of infringement is not overcome, if the novelty feature of a patent is used at all, merely by showing that such use is negligible in degree, and that the party infringing does not actually rely upon such use. I believe that is contrary to the principle that we must follow in a case of this kind. If the novelty exists in the device, and if it has any effect at all, the fact that it is counteracted at times entirely, and at other times only partially, by some other element which is not, as in the present case, claimed to be in itself novel, this is not a sufficient answer to the charge of infringement. As already pointed out, it would appear to be largely a question of the type of filter used, whether or not the hum is eliminated in the filter.

I am not unmindful of the parts of the testimony in the Delaware case which have been stipulated into the present case, to the effect that it did not make any difference in the alleged infringing device in the Delaware case whether the coils were in phase opposition or not. But I revert again to what Judge Morris said in his opinion in that case (page 461): "Defendant's mode of operation is the direct antithesis of that of the device of the patent, which intentionally employs neutralization by direct phase opposition." I can not accept the contention that defendants do not employ direct phase opposition in the present case, because it is in the testimony that they do. I do not think the intent as to what shall be the effect of that employment is the controlling element. In short, the fact that one may infringe poorly, does not absolve him.

There is a good deal more, of course, that might be added to what I have said, but I believe that I have

sufficiently covered the material issues,—those of validity and infringement,—and it is not necessary to become more analytical, or to go further into the details of the subject, especially since the parts of Judge Morris' opinion which I am adopting as part of this opinion, very clearly set forth the details and functioning of plaintiffs' device.

Due consideration has been taken of the fact that the device which defendants placed in evidence,—one of its own models,—more nearly supported their contention than did the device which plaintiffs introduced as being a similar model of the defendants. But I think that a case of this kind is not to be decided solely upon what one or the other of the models may disclose to the human ear by tests made in court, but those tests must be weighed in relation to all other considerations that are involved, and I can not escape the conclusion that we have here a device,—the defendants' device,—which certainly very much more closely approaches plaintiffs' device in its makeup and functioning than did the defendant's device in the Delaware case. I furthermore believe that, had this greater similarity been present before Judge Morris, from the clear intent of the wording which he employed in his opinion, he would have found that such device infringed the present patent, as I now find the defendants' device in the present case infringes.

I will sign a decree in conformity with this opinion.

FINAL DECREE.

Filed 20th July, 1934.

At a Stated Term of the District Court of the United States for the District of Maryland held at the United States Court House and Post Office Building, City of Baltimore, on the 20th day of July, 1934.

Present: Hon. William C. Coleman, United States Judge.

Percival D. Lowell, Francis W. Dunmore, and Dubilier Condenser Corporation, Plaintiffs, vs. A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Tripplett, Jr., and The Baltimore Gaslight Company, Defendants.	In Equity No. 2193. On U. S. Letters Patent Nos. 1,455,141 1,606,212 1,635,117

This cause having come on for hearing preliminary upon a motion filed by the defendants to dismiss the bill of complaint as to patents No. 1,455,141 and No. 1,635,117, because of unreasonable delay in the filing of disclaimers with respect to said patents, and after hearing counsel for the respective parties, the motion to dismiss for unreasonable delay having been denied, and thereupon the defendants, by counsel and leave of court, having filed an amendment to the answer, and the defendants by their counsel in open Court and by leave of Court having renewed the said motion to dismiss and further moved to dismiss the bill as to said patents because of inadequacy of disclaimers as filed, and the same having been heard upon the papers filed by the parties upon said previous motion, and the previous ruling having been adhered to and the motion to dismiss having been granted for the reasons set forth in the opinion, the cause proceeded to trial upon the pleadings and the facts and evidence was adduced with respect to patent No. 1,606,212, and counsel for the respective parties having been heard, it is thereupon

ORDERED, ADJUDGED AND DECREED in accordance with the opinion rendered herein:

1. That plaintiffs herein, Percival D. Lowell and Francis W. Dunmore are the owners, and the plaintiff Dubilier Condenser Corporation is their exclusive licensee of United States Patent No. 1,606,212.

2. That said United States Letters Patent No. 1,606,212 are as to claims 1-9 inclusive, and each of them, good and valid in law.

3. That the defendants, A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore

Gaslight Company, and each of them, having infringed upon claims numbered 1 to 9, inclusive, of United States Letters Patent No. 1,606,212 by selling power amplifiers and loud speakers included in Stewart Warner receiving sets designated as Number 109 which contain and embody the invention and improvement of such claims.

4. That a permanent injunction issue out of and under the seal of this Court directed to the said defendants, A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, and each of them, perpetually enjoining and restraining them, their officers, associates, agents, attorneys, servants, workmen, and employees, and each of them, from directly or indirectly making or causing to be made, using or causing to be used, leasing or causing to be leased, advertising or offering for sale, use or lease or causing to be advertised or offered for sale, use or lease, agreeing or contracting to sell or lease or causing to be agreed or contracted for sale or lease, supplying or causing to be supplied, installing or causing to be installed or threatening to offer or contract for sale, lease or supply, or disposing of in any manner power amplifiers, loud speakers, or other apparatus containing or embodying the invention and improvement or involving the use of the invention and improvement of said United States Letters Patent No. 1,606,212, or any substantial, material or vital part or parts thereof, and from infringing upon or contributing to the infringement of said United States Letters Patent in any way whatsoever.

5. That the plaintiffs, Percival D. Lowell, Francis W. Dunmore, and Dubilier Condenser Corporation, do recover from the defendants, A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company such gains, profits and advantages which the said defendants have derived, received, or made by reason of said infringement of said Letters Patent No. 1,606,212; and that the plaintiffs do recover of said defendants any and all damages which the plaintiffs have sustained or shall sustain by reason of said infringement by said defendants.

6. It is hereby referred to Louis J. Burger, Esquire, as a Master of this Court, to take and state an account of such gains, profits, and advantages, to assess plain-

tiffs' damages, and to report thereon to this Court with all convenient speed. The defendants, their officers, associates, agents, attorneys, servants, workmen, and employees are hereby directed and required to attend the aforesaid Master from time to time as required and to produce before him such apparatus, books, documents and papers and to submit to such oral examination or otherwise as the said Master may require in connection with said accounting and the assessing of said profits and damages.

7. That the bill of complaint herein, insofar as it relates to said United States Letters Patent No. 1,455,141 and No. 1,635,117, be and the same hereby is dismissed.

8. That the plaintiffs recover from the defendants the costs of this suit, insofar as they relate to Patent No. 1,606,212, to be taxed by the Clerk, and that the defendants recover from the plaintiffs the costs of this suit insofar as they relate to Patents Nos. 1,455,141 and 1,635,117.

July 20, 1934.

WILLIAM C. COLEMAN,
United States District Judge.

Approved as to form:

C. V. EDWARDS,
Of Counsel for Plaintiffs.

SAMUEL E. DARBY, JR.,
Of Counsel for Defendants.

ASSIGNMENT OF ERRORS ON BEHALF OF PLAINTIFF.

Filed 15th August, 1934.

(Style of Court and Title omitted.)

Now come the plaintiffs in the above entitled cause and file the following assignment of errors upon which they will rely upon their prosecution of the appeal in the above entitled cause from so much of the decree made by this Honorable Court and made and entered on or about the

20th day of July, 1934, as dismissed the bill of complaint with respect to United States Letters Patent No. 1,455,141 and 1,635,117.

1. The Court erred in dismissing the bill of complaint as to Letters Patent No. 1,455,141 and No. 1,635,117.

2. The Court erred in granting defendants' motion to dismiss the bill of complaint as to Letters Patent No. 1,455,141 and 1,635,117.

3. The Court erred in not overruling defendants' motion to dismiss the bill of complaint as to Letters Patent No. 1,455,141 and 1,635,117.

4. The Court erred in excluding the testimony and exhibits offered on behalf of the plaintiffs and marked under Equity Rule 46 on the issues of validity and infringement by defendants of said Letters Patent 1,455,141 and 1,635,117.

5. The Court erred in holding and deciding in effect that notwithstanding evidence offered on behalf of plaintiffs and duly marked under the provisions of Equity Rule 46 the plaintiffs' case is controlled by the decisions of the Circuit Court of Appeals of the Third Circuit in Radio Corporation of America v. Dubilier Condenser Corporation, Percival D. Lowell and Francis W. Dunmore as to the issues of the validity of Letters Patent 1,455,141 and 1,635,117.

6. The Court erred in not holding that the weight to be given to the decisions of the Circuit — of Appeals for the Third Circuit in Radio Corporation of America vs. Dubilier Condenser Corporation, Percival D. Lowell and Francis W. Dunmore is only that required by comity and in not holding that the evidence and exhibits offered on behalf of the plaintiffs and marked under Equity Rule 46 was sufficient to show that the bases of fact upon which said decisions were rested were erroneous and that upon the implied reasoning of said opinions Letters Patent 1,455,141 and 1,635,117 involve patentable invention and are good and valid in law.

7. The Court erred in not holding Letters Patent 1,455,141 and 1,635,117 to be valid and infringed upon by defendants.

8. The Court erred in not granting plaintiffs the relief as to patents numbered 1,455,141 and 1,635,117 prayed for in the bill of complaint.

WHEREFORE, plaintiffs pray that so much of said decree as dismissed the bill of complaint with respect to Letters Patent No. 1,455,141 and No. 1,635,117 be reversed; that said District Court for the District of Maryland be ordered to enter a decree in favor of the plaintiffs with respect to said patents as prayed for in the bill of complaint herein.

SEMMES, BOWEN & SEMMES,

Solicitor for Plaintiffs.

C. V. EDWARDS,

Of Counsel for Plaintiffs.

ASSIGNMENT OF ERRORS ON BEHALF OF DEFENDANTS.

Filed 11th August, 1934.

(Style of Court and Title Omitted.)

The defendants, A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, herein, conceiving themselves aggrieved by the decree entered herein on the twentieth day of July, 1934, now appear by their counsel and present with the accompanying petition for appeal from said decree the following assignment of errors.

1. The District Court erred in holding that Dunmore and Lowell patent #1,606,212 is valid.

2. The District Court erred in holding that the said patent discloses, or the claims thereof define, any patentable invention.

3. The District Court erred in failing to hold the said patent to be invalid because of anticipation and/or want of invention.

4. The District Court erred in holding that the Stewart-Warner Model 109 radio broadcast receiver embodies the alleged invention of the said patent.

5. The District Court erred in holding that the Stewart-Warner Model 109 radio broadcast receiver infringes claims 1-9, or any thereof, of the said patent.

6. The District Court erred in holding in effect that any material differentiation in fact exists between the Stewart-Warner Model 109 radio broadcast receiver and the RCA-Victor radio broadcast receiver held by Judge Morris in the United States District Court for the District of Delaware not to infringe the patent.

A. G. TRIPLETT,

R. M. TRIPLETT,

A. NELSON,

C. M. TRIPLETT, JR., and
THE BALTIMORE GASLIGHT COMPANY

COOK & MARKELL,

By CHAS. MARKELL,

Solicitors for Defendants.

STIPULATION AS TO RECORD ON APPEAL.

Filed 8th October, 1934.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MARYLAND.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs, vs. A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, Defendants.	In Equity No. 2193

It is stipulated and agreed by and between counsel for the respective parties, that the Appeal of the Plaintiff and the cross-appeal of the Defendant shall be submitted and argued on one Record; that Rules 14 and 16 of the

United States Circuit Court of Appeals for the Fourth Circuit shall apply to and govern the making up and printing of said Record, and that the following portions of the Record shall be incorporated in the transcript of record on appeal:

1. The pleadings, including

(a) Bill of complaint, including letters patent of which profert has been made in paragraphs 6 and 10;

(b) Defendants' answer;

(c) Defendants' motion to dismiss;

(d) Plaintiffs' answering affidavit.

2. The condensed narrative statement of proceedings and testimony as approved by the parties.

3. Plaintiffs' proffer of evidence under Rule 46 with exhibits attached thereto as follows:

A. Paper Exhibits

4. Dubilier license dated Oct. 20, 1924

7. Dubilier catalogue describing Super-Ducon

7a. Blueprint of wiring diagram of Super-Ducon

14. Time cards, monthly reports and laboratory notebook of Francis W. Dunmore.

15. Photograph of Type A relay.

16. Wiring diagram of Type A relay.

17. Photograph of Bureau of Standards set.

18. Wiring diagram of Bureau of Standards set.

21. Newspaper and Periodical articles, as follows:
New York Globe April 25, 1922, pp. 13
Washington Herald, April 14, 1922, pp. 8
New York Times, April 25, 1922, pp. 9
Washington Star, April 24, 1922, pp. 10
Washington Post, April 25, 1922, pp. 8
A.I.E.E. Journal, Dec., 1922, pp. 488-490
Telephony, Sept. 16, 1922, pp. 21-22

Q.S.T., Oct., 1922, pp. 32-35
Radio, Sept., 1922, pp. 27-28
Radio News, pp. 441
Radio Broadcast, Oct., 1922

22. Photograph of Type B relay.

29. Photograph of Dunmore's laboratory at home.

47. Photograph of Box type.

49. Photograph of Freed-Eisemann set wired for A. C. and rectifier.

50. Diagram of Lowell & Dunmore box set.

53. Publications as follows:—
A.I.E.E. Journal, April, 1922, pp. 242-246
Radio News, July, 1922
Radio, Mar. 1922

55. Electrical Journal, Dec., 1922, pp. 501-505

59. Radio, Nov., 1922, pp. 838-39, 1001-02

60. Radio Phone Receiving, published 1922, D. Van Nostrand Co. N. Y. C.

61. Radio Phone Receiving, pp. 73-76

62. Textbook of Radio, published by Technical Book Co., N.Y.C. 1922

63. Textbook of Radio, pp. 175, 183

64. Textbook of Radio, p. 185.

65. Radio Phone Receiving, p. 134.

66. Textbook of Radio, pp. 177-182, 187

67. Diagram including Fig. 1 of patent 1,455,141 and form of current in different sections.

69. Wiring diagram of Panels A to J inclusive.

70. Wiring diagram of Panels A, B, C, D, E, F combined.

71. Wiring diagram of Panels A, G, C, H, E, F combined.

72. Wiring diagram of Panels A, I, C, J, E, F combined.

74. Stipulation as to Defendants' circuit (Same as Plaintiffs' Ex. 93).

75. Colored photostats of wiring diagram of Defendants' sets SW 104, 105, 106, 108, 109. (109 same as Pltffs' Ex 94)

76. Schematic diagram of Super-heterodyne

77. Simplified colored diagram of circuits of Defendants' sets SW 104, 105, 106, 108, 109. (109 same as Pltffs' Ex. 95)

79. Filter test diagram SW set 109.

80. High frequency test diagram SW set 109.

81. Grid bias diagram SW sets 104, 105, 106, 108, 109.

83. Time cards, monthly reports and laboratory notebook of Percival D. Lowell

84. Pencil description of AC amplifier made by Lowell at Arcade Bowling Alleys.

85. Photograph of Bureau of Standards AC set with Lowell.

86. Pittsburgh Post, June 6, 1923, Radio section p. 1.

87. Dunmore checks to Brady dated June 29, 1922 and to Commissioner of Patents dated Mar. 25, 1922.

B. Physical Exhibits

7b. Super-Ducon

8. Westinghouse RA-Da receiving set

9. Magnavox loud speaker

19. Bureau of Standards receiving set

20. Rectifying unit for Bureau of Standards receiver
23. Original Type B relay
24. Radio Instrument Co. AC set.
25. Rectifier unit for Radio Instrument set.
26. Box Type Lowell & Dunmore receiver.
27. Freed-Eisemann set wired for AC by Lowell & Dunmore.
28. Rectifier for Freed-Eisemann set wired for A.C.
48. Box type receiver set.
68. Demonstration set Panels A to J inclusive.
73. Capacity and resistance coupling unit.
78. Stewart-Warner set 109. (Same as Pltffs' Ex. 91)
82. Table cabinet for SW set 109. (Plaintiffs' Ex. 91)

4. Plaintiffs' Exhibits as follows:

A. Paper Exhibits

90. United States Letters Patent 1,606,212.
92. Wiring diagram of test on Defendants' Set SW 109.
93. Stipulation covering sale of sets by Defendants and correctness of wiring diagrams including sets SW 104, 105, 106, 108, 109.
94. Colored photostat of set SW 109.
95. Simplified diagram of set SW 109.
96. Copy of speaker circuit wiring diagram made on blackboard by Witness, Dr. Lee.
97. Christian Science Herald, Jan. 10, 1928, p. 10.
98. Letter to Magnavox from Dunmore dated June 10, 1922; reply of Magnavox thereto dated June 19, 1922 and reply of Dunmore thereto dated June 28, 1922.

99. Letter to General Electric Co. July 28, 1923 and reply thereto dated Aug. 3, 1923.

100. Letter to Westinghouse Elec. & Mfg. Co. dated July 28, 1923 and reply thereto dated Aug. 3, 1923.

101. License to Brandes Products Corp. dated Oct. 1, 1927.

102. License to Grigsby-Grunow-Hinds Co. dated Nov. 28, 1927.

105. Letter from Plaintiffs to Defendants dated Aug. 5, 1933 notifying of infringement

106. Bureau of Standards publication, Oct. 1922, No. 450.

107. Copy of spring analogue diagram drawn on blackboard by witness Lowell.

108. Instruction book accompanying Majestic set.

109. Wiring diagram of connection for test of hum in filter output.

B. Physical Exhibits

91. Defendants' set SW 109.

103. Majestic set manufactured by Grigsby-Grunow under license.

104. Bread board model panels A to J inclusive.

5. Defendants' Exhibits as follows:

A. Paper Exhibits

A. Wiring diagram of RCA loudspeaker 104.

B. Langmuir patent 1,282,439.

C. Hull patent 1,251,377.

D. White patent 1,195,632.

E. Robinson patent 1,587,084.

F. Pridham & Jensen patent 1,105,924.

G. File wrapper and contents of Patent 1,606,212.

H. Stipulated testimony of certain witnesses in suit of Dubilier Condenser Corporation et al. v. Radio Corporation of America in the District of Delaware. The testimony of these witnesses is included in item 2 and is not to be reproduced as a separate exhibit. The exhibits referred to in that testimony are to be reproduced as follows:

Plaintiffs' Exhibits

32. Diagram Current Path in Audio Amplifier Output circuit, Plaintiffs' Patent

33. Diagram Neutralization of hum in Output Circuit, Plaintiffs' Patent

34. Diagram Current Path for field winding Plaintiffs' Patent

35. Diagram Neutralization of Hum in Field Winding Circuit, Plaintiffs' Patent

36. Diagram Circuit Defendant's Loudspeaker 104

37. Diagram Loudspeaker 104 Current Path in Audio Amplifier Output Circuit

38. Diagram Defendant's Loudspeaker 104 Neutralization of Hum in Output Circuit

39. Diagram Defendant's Loudspeaker Current Path to field Winding

40. Diagram Defendant's Loudspeaker 104, Neutralization of Hum in Field Winding Circuit.

Defendant's Exhibits

77. Electrical Experimenter, Nov. 1919, pp. 636, 684, 686, 688, "Church Sermon Heard over One-half Mile"

78. Pridham and Jensen, U. S. Patent 1,105,-924, Aug. 4, 1914.

79. Simplified Schematic Diagram Radiola 28 connected to speaker, Model 104

80. Waterman Diagrammatic Sketch 104 Speaker Floating Coil Location

B. Physical Exhibits

I. Receiving Set acquired at Baltimore by counsel for Defendants', marked SW 109.

6. Opinion of Court.

7. Decree of the Court made and entered on or about July 20, 1934.

8. Assignment of Errors.

9. Stipulation of counsel as to record.

10. Memorandum of the Clerk.

11. Order to transmit record.

12. Clerk's certificate.

SEMMES, BOWEN & SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Plaintiffs.

C. V. EDWARDS
Of Counsel.

COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Defendants.

SAMUEL E. DARBY, JR.,
Of Counsel.

STIPULATION IN RE EXHIBITS TO BE INCORPORATED IN RECORD AND APPROVAL OF U. S. CIRCUIT COURT OF APPEALS.

Filed 10th October, 1934.

IN THE CIRCUIT COURT OF APPEALS OF THE UNITED STATES FOR THE FOURTH CIRCUIT.

A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company,
Appellants,

vs.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation,
Appellees.

STIPULATION.

To the Honorable, the Judges of the United States Circuit Court of Appeals for the Fourth Circuit:

Whereas, the Exhibits stipulated to be incorporated in the record on appeals number approximately fifty or more and include, in addition to copies of patents, many photographs, blue prints of drawings—

It is hereby stipulated and agreed by and between counsel for all of the parties, subject to the approval of the United States Circuit Court of Appeals for the Fourth Circuit, that the Exhibits stipulated to be incorporated in the Record on appeal need only be incorporated in ten of the twenty-four copies required to be filed with the Appellate Court under Section 1 of Rule 16, and that the said Exhibits be also included in the three copies of the printed Record to be furnished to the Appellant and the Appellee.

COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Appellants.

SAMUEL E. DARBY, JR., Counsel.
SEMMES, BOWEN & SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Appellees.

C. V. EDWARDS, of Counsel.

Approved this 10 day of Oct., 1934.

JOHN J. PARKER,
U. S. Circuit Judge.

STIPULATION IN RE EXHIBITS TO BE INCORPORATED IN RECORD AND APPROVAL OF U. S. CIRCUIT COURT OF APPEALS.

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SEMMES, BOWEN & SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Appellants.

C. V. EDWARDS, of Counsel.
COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Appellees.

SAMUEL E. DARBY, JR., Counsel.

Approved this 10 day of Oct., 1934.

JOHN J. PARKER,
U. S. Circuit Judge.

STIPULATION AS TO PLAINTIFFS' EXHIBITS TO BE TREATED AS PHYSICAL EXHIBITS AND APPROVAL OF APPELLATE COURT.

Filed 11 October, 1934.

IN THE CIRCUIT COURT OF APPEALS OF THE UNITED STATES FOR THE FOURTH CIRCUIT.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation,
Appellants,

vs.

A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company,
Appellees.

A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company,
Appellants,

vs.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation,
Appellees.

STIPULATION AS TO CERTAIN EXHIBITS

To the Honorable, the Judges of the United States Circuit Court of Appeals for the Fourth Circuit:

It is hereby stipulated and agreed subject to the approval of the Court by and between counsel for the parties hereto that in lieu of reproduction in the printed record, the following exhibits may be treated as physical exhibits provided, however, that any party hereto so desiring may submit to the Circuit Court of Appeals at the time of the argument of the above appeal three copies of any of said exhibits.

Plaintiffs' Exhibits

14. Time cards, monthly reports and laboratory notebook of Francis W. Dunmore
55. Electric Journal, December, 1922, pages 501-505
60. Radio Phone Receiving, published 1922, D. Van Nostrand Company, New York City
62. Text Book of Radio, published by Technical Book Company, New York City, 1922
69. (In part) Wiring diagrams of panels D, H and J
75. Colored photostats of wiring diagrams of defendants' sets SW 104, 105, 106, 108 and 109
83. Time cards, monthly reports and laboratory notebook of Percival D. Lowell
86. Pittsburgh Post, June 6, 1923, Radio Section, page 1
87. Dunmore checks to Brady dated June 29, 1922, and to Commissioner of Patents dated March 25, 1922
108. Instruction book accompanying Majestic set.

SEMMES, BOWEN & SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Appellants.

C. V. EDWARDS, of Counsel.
COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Appellees.

SAMUEL E. DARBY, JR., of Counsel.
SEMMES, BOWEN & SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Cross-Appellees.

C. V. EDWARDS, of Counsel.
COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Cross-Appellants.

SAMUEL E. DARBY, JR., of Counsel.

Dated: October 11, 1934.

Approved:
JOHN J. PARKER,
Senior Circuit Judge.

STIPULATION WAIVING CERTIFICATION OF CERTAIN EXHIBITS.

Filed 22 October, 1934.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MARYLAND.

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation,
Plaintiffs,
vs.
A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company,
Defendants

In Equity No. 2193.

It is stipulated and agreed by and between counsel for the respective parties that certification by the Clerk of the District Court of the United States for the District of Maryland of the physical exhibits of the plaintiffs and the defendants numbered and described in items 3B, 4B and 5B of the stipulation heretofore filed as to making up the transcript of record on the appeals herein is waived and said exhibits shall be retained in the custody of the respective parties and presented by the respective parties to the Circuit Court of Appeals for the Fourth Circuit at the argument of the appeals in the said Court.

SEMMES, BOWEN AND SEMMES,
By GAYLORD LEE CLARK,
Solicitors for Plaintiffs.

C. V. EDWARDS, of Counsel.

COOK & MARKELL,
CHAS. MARKELL,
Solicitors for Defendants.

SAMUEL E. DARBY, JR., of Counsel.

MEMORANDUM OF THE CLERK.

(1) Petition for Appeal on behalf of Plaintiffs filed 15th August, 1934.

(2) Appeal granted, 15th August, 1934.

(3) Appeal bond waived by Stipulation.

(4) Citation. Dated 15th August, 1934. Service acknowledged 17th August, 1934.

(5) Petition for Appeal on behalf of Defendants filed 11th August, 1934.

(6) Appeal granted, 11th August, 1934.

(7) Appeal bond waived by Stipulation.

(8) Citation. Dated 11th August, 1934. Service acknowledged 16th August, 1934.

ORDER TO TRANSMIT RECORD.

And, thereupon, it is ordered by the Court here that a transcript of the record and proceedings of the cause aforesaid, together with all things thereunto relating, be transmitted to the said United States Circuit Court of Appeals for the Fourth Circuit, and the same is transmitted accordingly.

Teste: ARTHUR L. SPAMER,

Clerk.

CLERK'S CERTIFICATE.

UNITED STATES OF AMERICA,

District of Maryland, to-wit:

I, Arthur L. Spamer, Clerk of the District Court of the United States for the District of Maryland, do hereby certify that the aforegoing pages from 1 to 295, both inclusive constituting Volume I, together with 603 pages of Exhibits bound together in a separate binding entitled "Volume of Exhibits," being Volume II, and certified accordingly, constitute and is a true transcript of the record and proceedings of the said District Court, together with all things thereunto relating in the therein entitled cause of Percival D. Lowell, et al., vs. A. G. Triplett, et al., No. 2193 Equity Docket, made up in accordance with Stipulation of Counsel for the respective parties filed in said cause.

In Testimony Whereof I hereunto set my hand and affix the seal of said District Court this 14th day of December, A. D. 1934.

ARTHUR L. SPAMER,

(Seal of Court.) Clerk of said District Court.

PROCEEDINGS IN THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FOURTH CIRCUIT

No. 3816

PERCIVAL D. LOWELL, FRANCIS W. DUNMORE and DUBILIER CONDENSER CORPORATION, Appellants and Cross-Appellees,

versus

A. G. TRIPLETT, R. M. TRIPLETT, A. NELSON, C. M. TRIPLETT, JR., and THE BALTIMORE GASLIGHT COMPANY, Appellees and Cross-Appellants

Cross-Appeals from the District Court of the United States for the District of Maryland, at Baltimore

December 15, 1934, the transcript of record is filed and the cause docketed.

Same day, the original petition for appeal, order allowing appeal, and citation are certified up under Section 7 of Rule 14.

Same day, the original petition for cross-appeal, order allowing cross-appeal, and citation are certified up under Section 7 of Rule 14.

Same day, original stipulation waiving bonds is certified up.

STIPULATION AS TO DEFENDANTS' EXHIBIT G, APPROVED BY JUDGE PARKER—Filed October 23, 1934

[Style of Court and Title omitted]

It is hereby stipulated and agreed, subject to the approval of the Court, by and between counsel for the parties hereto, that in lieu of reproduction in the printed record, Defendants' Exhibit G, File Wrapper and Contents of Letters Patent No. 1,606,212 may be treated as a physical exhibit; provided, however, that any party hereto so desiring may sub-

mit to the Circuit Court of Appeals at the time of the argument of the above appeal three copies of said exhibit.

Semmes, Bowen and Semmes, by Gaylord Lee Clark, Solicitors for Appellants. C. V. Edwards, of Counsel.

Cook & Markell, Chas. Markell, Solicitors for Appellees. Samuel E. Darby, Jr., of Counsel.

Cook & Markell, Chas. Markell, Solicitors for Cross-Appellants. Samuel E. Darby, Jr., of Counsel.

Semmes, Bowen and Semmes, by Gaylord Lee Clark, Solicitors for Cross-Appellees. C. V. Edwards, of Counsel.

Approved.

John J. Parker, Senior Circuit Judge.

Dated: October 22, 1934.

December 15, 1934, the appearance of Clifton V. Edwards is entered for the appellants and cross-appellees.

Same day, the appearance of Samuel E. Darby, Jr., is entered for the appellees and cross-appellants.

Same day, four orders extending the time for the filing of the transcript of record are filed.

ADDENDUM TO TRANSCRIPT OF RECORD—Filed December 19, 1934

ADDENDUM TO

TRANSCRIPT OF RECORD

UNITED STATES OF AMERICA,

District of Maryland, to wit:

At a District Court of the United States for the District of Maryland, begun and held in the City of Baltimore on the first Tuesday in June, (being the 5th day of the same month) in the year of our Lord one thousand nine hundred and thirty-four.

Present: The Honorable William C. Coleman, Judge Maryland District; Bernard J. Flynn, Esq., Attorney; August Klecka, Esq., Marshal; Arthur L. Spamer, Clerk.

Among other were the following proceedings, to wit:

Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs, VERSUS A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, Defendants.	In Equity No. 2193.

DEPOSITIONS OF WITNESSES IN THE CASE OF DUBILIER CONDENSER CORPORATION AND FRANCIS W. DUNMORE V. RADIO CORPORATION OF AMERICA; AND, DUBILIER CONDENSER CORPORATION, PERCIVAL D. LOWELL, AND FRANCIS W. DUNMORE, V. RADIO CORPORATION OF AMERICA IN THE DISTRICT COURT OF DELAWARE; GEORGE H. LEWIS, JOHN B. BRADY, ROY E. SWEENEY, JOSEPH D. R. FREED, ALEXANDER ERNEST REOCH, AND JOHN H. DELLINGER, AND STATEMENT OF COUNSEL REFERRED TO IN PROFFER OF EVIDENCE UNDER RULE 46 IN VOLUME I, PAGES 230-262 INC. OF RECORD.

GEORGE H. LEWIS.

GEORGE H. LEWIS, called as a witness on behalf of the plaintiffs, being duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. NEAL:

MR. LEWIS: My contact with the development of radio is as follows:

In 1909 I was a member of the Signal Corps of the Army and I was in the work of developing the radio signals for the Signal Corps and light house service. That continued until 1915, when I was appointed radio expert aide in the Navy in similar developments for the Navy Department. About two years after the war I resigned from the Navy and became associated with Powel Crosley of Cincinnati, the Crosley Radio Corporation and there I was assistant to the president in charge of research work as well as matters of sales and executive policies of that organization relating to radio and radio receiving equipments and broadcasting.

Since 1923 the Crosley Corporation has occupied a position of one of the large three in producing equipment in the United States, the other two being Atwater Kent and Radio Corporation of America.

In 1922 and 1923, so far as I know there were no sets on the market using alternating current, as power for the tubes. Our organization was not active in any development work, and had no knowledge of it. Our competitors that we knew of were not experimenting or putting a set of that type on the market.

While I was with Crosley, probably 50 per cent. of my time was consumed in visiting conventions, conferences, technical assemblies, plants of other manufacturers abroad, making notes, and watching very carefully the development of radio that might affect our business. Throughout the early periods of broadcasting, the design of radio receivers varied very rapidly and a new type might come on the market over night that would make obsolete most of the types in production. We appreciated

very keenly that we must keep our eyes open and take advantage of any new developments that would affect our business.

No investigation had been made of the possibility of operating radio receiving sets from alternating current power in 1922, so far as my knowledge goes. The usual house wiring circuit is 110 volts alternating current.

In the latter part of 1923, I heard an alternating current set had been developed in Washington. In the early part of 1924, I visited Washington with Mr. Crosley as members of the Hoover Radio Conference; they were called to consider certain problems in broadcasting, by then Secretary Hoover. While in Washington, I mentioned to Mr. Crosley that there was an A. C. operated receiver in Washington, and asked him would he like to see it. I had been talking to him about this receiver. I asked Mr. Brady, John Brady, would he make arrangements whereby Mr. Crosley could see this receiver. Mr. Crosley and I went out to Mr. Dunmore's house one evening. It was in the early spring, I recall. They had a fire in the fireplace, and that was the first alternating current receiver that I had ever seen.

Q. 21. How did you happen to inspect that speaker and receiver, was it merely academic interest?

A. Oh, no. We were keenly interested in any new development that might come on the market and we felt called upon to be prepared to know the workings of it, and the cost of it, and if it was possible to adapt our receiver.

Q. 22. Did you make any arrangements with Mr. Dunmore or any of his representatives to go ahead with A. C. operated sets?

A. At the time we inspected this receiver, it was so different from the type of equipment we were making, that we did not know about the rectifier part of it. It looked to us as a very complicated instrument. Crosley was noted at that time for producing a very simple and cheap receiver, and when we looked at this one with transformers and switches and one thing and another, we asked Dunmore if it would cost very much to produce a

receiver of that type in our chassis, utilizing our condensers and coils. In fact, we asked him would he convert one of our battery receivers into this A. C. job.

(Narrative continued.) The receiver was in operation when we inspected it, and we tuned in on the stations in Washington, and listened very carefully to one operation. This is the receiver.

MR. NEAL: Please note in the record that witness identifies the receiver in box with hinged lid which we will mark for identification as Plaintiff's Exhibit A.

(Received and marked "Plaintiff's Exhibit A for Identification.")

Alternating current operated receivers were just brought out commercially, from my recollection the latter part of 1925, or the beginning of 1926. The Radio Corporation of America first brought out an alternating current operating receiver in the latter part of 1925 or the beginning of 1926.

MR. NEAL: Direct examination closed.

CROSS-EXAMINATION BY MR. BARUS:

MR. LEWIS: I began my service in the Signal Corps in 1909, and then I was an expert with the Navy, in 1914. I remained with the Navy throughout the war. My expert work in the Navy consisted of having charge of the design and manufacture of transmitters and receivers in 1917, up until the first of the war. During the middle part of the war I was placed in charge of the Design Division in Washington, where we prepared all the specifications for radio equipment, purchasing, testing, and installing radio equipment on commercial and naval vessels.

I left the Navy two years after the war, the last of 1919 and beginning of 1920.

Next I went with Fritz Lowenstein, the Lowenstein Radio Corporation, and Lowenstein died a short while after that, and after that time I went with Mr. Crosley in the latter part of 1922, just before Christmas. I

should say a dozen broadcasting stations were operating at that time.

Mr. Crosley was making radio receivers of the radio frequency type, when I first went with him. Directly after that we acquired the Precision Equipment Company, licensed by the Westinghouse Company under the regenerative circuit. At that time we made the regenerative detector with tuned radio frequency preceding. I think he still continues to make one. I am not sure about that. When I left him he was making one, which was two years ago. He continued throughout the period I was with him to make a tuned radio frequency receiver. That was the principal type of set, which he made from 1922 on until the time I left him. He always made a regenerative receiver, also a tuned radio frequency receiver. He always had one in his line. The tuned radio frequency receiver was a regenerative receiver at the time he took the license from Westinghouse. He made a regenerative receiver without the tuned radio frequency when he first acquired the license. The models in his line, consisted of seven or eight different type of sets. There was always a model in the line, which was the regenerative detector, a one-tube set. In fact, we had one called the "Crosley Pup," a little set about that big (indicating).

That was in 1923. The latter part or beginning of 1924, we made that small "pup" receiver, I speak of.

He first began to make the regenerative receiver without the tuned radio frequency stage, at the time he acquired the Precision Equipment Company, which I think was the latter part of 1923. He acquired the license to manufacture these receivers in the latter part of 1923. It was at that time he started to make the regenerative detector.

After Christmas, there was little business in 1923. I should say half of the receivers made by Crosley were tuned radio frequency, and the other half consisted of a single regenerative detector receiver that used ear phones.

In the year 1924, the tuned radio frequency receiver was a regenerative receiver. I should say that more than

half of them were regenerative receivers, having tuned radio frequency ahead of the regenerative detector.

I do not recall what means of stabilization was employed for the tuned radio frequency receivers which Crosley made in 1922, whether he had grid suppressors or not at that time.

If I correctly recall he controlled regeneration with his filament temperature. Some receivers had two stages of radio frequency.

Crosley did not manufacture the alternating current receiving set in 1922 because we knew nothing about an alternating current receiving set in 1922.

Crosley did not manufacture an alternating current receiving set in 1923 because we saw our first alternating current operated set in 1923, or the beginning of 1924. We knew nothing about it in 1923. We knew nothing about an alternating current set, hence he could not manufacture them.

Early in the spring of 1924, we saw our first alternating current set in Washington. This set appeared to us to be extremely complicated. It had switches, attachments to the light socket. It had large transformers, very much larger than the type we were accustomed to make, which were audio transformers. Crosley was noted as the Ford of the radio, and his receivers were very cheap. Merchandise of the pocketbook class. We considered if we put all that equipment in there, it would cost maybe two or three times as much as we made and were selling quite a large volume of. Hence, economically, it was not wise for Crosley to change and make that set, particularly as none of his competitors were making a set of that type.

The 104 loud speaker of the Radio Corporation appeared on the market in 1925 or the beginning of 1926. I cannot say whether it was September, 1925, but the latter part of 1925 or the beginning of 1926. That speaker had in it an electrodynamic loud speaker.

I cannot say how extensively the Radio Corporation 104 loud speaker was sold on the market from the time

of its appearance, but I have seen them on dealers' shelves and jobbers' establishments.

Both the National Electric Manufacturers' Association and the Radio Manufacturers' Association have repeatedly called committees in the last two years to define an alternating current set and today they have not reached an agreement. In my opinion a set using batteries either in the A, B or C circuit is not an alternating current set, in spite of the fact that it uses smoothing out means for its plate. Any battery in a set does not make it a complete alternating current set.

A set which was operated from a storage battery for its A supply but has a trickle charger or the like supplying the A battery and its B and C supply from an alternating current source. In these meetings I speak of I had repeatedly defined that as an electric set and not an alternating current set.

The first alternating current operated set, as I have defined it, appeared on the market to my knowledge, the beginning of 1926 or the latter part of 1925.

The Garod Corporation had a set that was developed by Ben Miessner using no batteries. This set used the McCullough alternating current tubes and had no batteries. The Radio Corporation of America also had a superheterodyne that used no batteries.

I was with the Crosley Company from the latter part of 1922 until two years ago. I resigned two years ago to become associated where I am now.

I am now vice-president and general manager of the Arcturus Radio Corporation, who manufacture only alternating current tubes.

Because of the popularity of the alternating current set at the present time and in order that it might have a small number of tubes to produce, we concentrate our efforts on producing only alternating current tubes.

Those tubes are entirely different from the direct current operated set tubes. Certain features in the design

of an alternating current tube are not required in a direct current tube.

I cannot identify the Navy 1605-B amplifier by that number. I was not familiar with the radio receivers after the middle of the war when I was placed in charge of the design division. At that time the receiver was separated from the transmitter and from that time on I was not particularly familiar with the receiver.

With respect to these alternating current tubes which I am manufacturing, they are tubes of that kind useful in connection with the operation of alternating current receiving sets.

It is possible to arrange a circuit whereby you can operate a set on alternating current no matter what type of tube you use, but you will have more difficulty.

The receiver that I saw demonstrated by Mr. Dunmore had a detector that was not an A. C. tube operated by alternating current, which set I believe is that receiver there (indicating).

The Garod set produced by Meissner used an ordinary detector tube, a direct current tube and that operated very satisfactorily. I studied the diagram and inspected the set produced by Garod and I am familiar with that set and also its detector which was a direct current 199 tube. It was operated by the current from the plate circuit of the power tube, but there were no batteries in the circuit at all. The current for the tube was fed to it by the plate of the power tube. I would not testify that that was direct current.

In the Garod receiver there were two types of tubes, one of them was of the low voltage type. At that time Meissner wrote a paper and gave it before the Radio Club of America and shortly after that there was a wild clamor on the part of most tube manufacturers and radio receiver manufacturers to make sets having those tubes. Theretofore the tubes were operated at a filament potential of around six volts. Meissner proposed to use one volt or less and in that class he produced and placed on the market a tube of the low voltage. The Radio Cor-

poration placed on the market the 226 tubes and those tubes were designed for alternating current use.

The Meissner tubes are like the 226 tubes in some respects. They had a heavy stock filament, grid, plate, and glass bulb, base. They differed materially from any tube in use at that time for direct current sets.

With respect to the Garod detector tube, Meissner had designed circuits using one of those A. C. tubes as a detector, but the balancing method and the cost of eliminating the hum he claimed was excessive. The tube which he did use for the Garod detector was a 199 direct current tube designed as a direct current tube. In his paper delivered before the Radio Club of America, Meissner made note of a condition between hum and filament power, whereby he found the smaller the voltage, electric power, in the filament circuit, the smaller would be the hum. Hence he selected the 199 purposely for its application in this receiver to minimize the hum.

I have never seen the graph of a plate current and I could not testify that the current which runs in the plate circuit of a power tube is an alternating current. It is characteristic of most tubes that the current will only pass in one direction through the plate circuit.

The current which lighted the 199 detector of the Garod set, being supplied from the plate circuit of the power tube is not an alternating current nor a direct current such as we obtain from a battery. When we used the batteries we used them to get a direct current, of uniform amplitude. Should that amplitude vary up and down it would give a hum in the detector tube. It is that characteristic that I spoke of when I said that I would not testify that that was a pure direct current. I do not know the condition of the current in the plate circuit of that Garod tube. I have no knowledge as to the character of the amplitude of the current in the plate circuit of that power tube, whether it is an alternating current or not. Supposing it was an alternating current, the effect would be, if it had not been smoothed out at all and the 199 tube were used as the detector that it would cause the detector to hum. How much it would hum depends on how much it was smoothed out, and that depends on

how much it is filtered. How much an alternating current on the filament of a 199 tube will cause it to hum, depends on how much you pay to make your filter in the case of an alternating current from an alternating current generator, but in the case of the voltage derived from the plate circuit of a power tube, I do not think so.

In the case of voltage derived from a rectifier tube, how much the voltage, derived from the rectifier tube, ripples, depends on the size and characteristics of the filter. If you want to pay enough money for your filter you can not make it as smooth as you please but as practical.

You can allow it to fluctuate more or less if it does not do any harm and build a cheaper filter.

By the proper selection of the tube used as a detector in the Garod set and by obtaining the voltage to operate that detector from particular sources, Meissner obtained a detector that operated satisfactorily. If a dry battery were put in there to light the plant of that detector tube, such as is usually used to operate a 199 tube, the set would operate, but it would not be an alternating current set.

During 1924-1925, for instance, there were on the market, various devices known as B-eliminators. These devices were a substitute for the B batteries of any receiving set having appropriate power demands for B supply. It made no difference what the source of A supply was, whether these B eliminators were effective. The A supply might be a storage battery and it might be a trickle charger or a dry battery. Some of these so-called B eliminators supplied both B and C voltage. And that also was independent of the fact that the filament might be lighted from a storage battery or a dry battery or any other appropriate source of current.

I would be willing to produce some circulars and diagrams showing the Crosley sets referred to in my testimony and the dates at which they appeared, but I have not them. I think I can write to Mr. Crosley and ask him if they are available.

RE-DIRECT EXAMINATION BY MR. NEAL:

When I listened to the operation of the alternating current receiver in Washington in 1924, the reception, as re-

gards quality, was very clear and satisfactory. My rank when I left the Navy was senior grade lieutenant. I attended the Naval Academy.

MR. NEAL: That is all.

(Witness excused.)

JOHN B. BRADY.

JOHN B. BRADY, called as a witness on behalf of the plaintiff, being first duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. EDWARDS:

MR. BRADY: My residence is Somerset, Maryland, occupation, patent lawyer.

I represented Messrs. Lowell and Dunmore in the taking out of the two patents in suit, No. 1,455,141 and 1,635,117.

I am familiar with the transactions subsequent to the filing of those applications concerning the exploitation or attempts to have the receiver put on the market by Messrs. Lowell and Dunmore.

From time to time Messrs. Lowell and Dunmore consulted with me with respect to their activities. I recall that the case first came to my office about the middle of January, 1922. Messrs. Lowell and Dunmore told me that they had succeeded in operating a radio receiver without batteries from the alternating current lighting source. The case impressed me considerably because I had had experience previously in radio receiver operation and I have been interested in the subject since 1908.

At the request of Messrs. Lowell and Dunmore I prepared the application which was ultimately filed. It was filed in March, 1922. In the process of preparing that application they demonstrated to me a complete receiver in operation at the Bureau of Standards. The receiver operated satisfactorily and impressed me as being of considerable novelty in the art.

I can point out a publication describing the receiver but the particular receiver is not here.

If I might refer to the publication in the Institute of Electrical Engineers for July, 1922, the complete de-

scription of the receiver that I saw at the Bureau of Standards appears therein. I might also refer to the Bureau of Standards leaflet No. 450 which describes the receiver, the photograph opposite page 351 shows the receiving apparatus and the rectifying unit as I saw the apparatus prior to the filing the application.

The apparatus constituted a multiplicity of stages of radio frequency amplification, a detector, and a multiplicity of stages of audio frequency amplification with a system of supplying power to the tubes for operating from the alternating current lighting circuit. There were means in the receiver for eliminating the hum arising from the lighting circuit supply.

This is the description of the American Institute of Electrical Engineers to which I refer—an article by P. D. Lowell.

MR. EDWARDS: I will offer in evidence pages 488 to 490 inclusive of the proceedings of the American Institute of Electrical Engineers and with the consent of the other side I will substitute another copy of this publication within a day or two. This is dated July, 1922.

(Received in evidence and marked "Plaintiffs' Exhibit No. 7." *See Exhibits, Volume III, page* 62.)

MR. EDWARDS: I also offer in evidence the publication of the Bureau of Standards of October 2, 1922, referred to by the witness.

(Received in evidence and marked "Plaintiffs' Exhibit No. 8." *See Exhibits, Volume III, page* 63.)

THE WITNESS: The set that is referred to in these specifications, is still at the Bureau of Standards. The operation of this receiver at the Bureau of Standards created considerable interest in the industry. Newspapers throughout the country carried descriptions of this apparatus and I recall that Messrs. Lowell and Dunmore received various offers of employment if they would commence the development and exploitation of such a receiver commercially. Mr. Lowell severed his connections with the Bureau of Standards and became chief engineer of the Radio Instrument Company and there

commenced the construction of an apparatus. The apparatus which Mr. Lowell constructed is available, the rectifier unit particularly is still here, and while the receiving apparatus per se has not been located, a unit somewhat similar to that apparatus is here to represent the general character of the equipment.

The Radio Instrument Company proposed to market the apparatus and after the instrument was successfully demonstrated endeavored to do this.

Mr. Lowell was taken ill about September, 1922, and they lost his services throughout the remainder of the year.

The Radio Instrument Company had a contract with Messrs. Lowell and Dunmore for the development of the apparatus and had a license for period of a year in which to develop the invention.

I shall try to locate a copy of the license with the Radio Instrument Company and have it available within the next day or two. That license ran until July, 1923.

After the expiration of that license the steps taken toward exploiting the invention were that Messrs. Lowell and Dunmore had me send a copy of their issued patent to the General Electric Company. I find a reply from the General Electric Company under date of May 25, 1923, in which they refer to this patent.

So far as I can recall now, all I did was to enclose a copy of the patent to one of the engineers of the General Electric Company. The patent was sent to Mr. Wendell L. Carlson of the General Electric Company. I do not believe I wrote a letter. I merely sent a copy of the patent.

Q. 21. Then you received a letter from the General Electric Company?

A. From Mr. Carlson under date of May 25, 1923, a copy of which I have. This is the letter which I received in reply to my letter to Mr. Carlson.

MR. EDWARDS: I offer in evidence this letter received from the General Electric Company. You admit that this letter was written by the General Electric Company?

MR. BARUS: I do not admit it was written by the General Electric Company. I have no objection to the letter.

(Received in evidence and marked "Plaintiffs' Exhibit No. 9." *See Exhibits, Volume III, page* 75.)

I did not reply further to that letter. Further action came principally by personal contact. I was advised that the General Electric Company was not that corporate body which would purchase patents from individuals and Messrs. Lowell & Dunmore desired to commercialize their invention. I only saw Mr. Carlson on this matter, and I was referred to the office of the Radio Corporation of America. Their Mr. Adams, the general patent attorney for the company, took the case under advisement and he consulted with me in my office at Washington.

I brought the patents to the attention of Mr. Adams. Mr. Adams wrote under date of November 16, 1923, to the effect that the Radio Corporation was not interested. I have the letter from Mr. Adams.

MR. EDWARDS: I offer the letter in evidence.

(Received in evidence and marked "Plaintiffs' Exhibit No. 10." *See Exhibits, Volume III, page* 76.)

As to the next step taken, I recall being invited to a demonstration by Messrs. Lowell & Dunmore about July 31, 1923, where the Radio Instrument Company set was demonstrated to me. The set operated satisfactorily from the alternating current lighting socket and the inventors told me at that time they were planning to construct a different set but they were having trouble getting materials, particularly the type of rectifier tube required in the power supply system. During the summer of 1923, I recall that the inventors were building that different type of set and the set was completed about the end of 1923 at which time I was again invited to the laboratory of Mr. Dunmore, where I heard this apparatus operating. That set is here and I can identify it.

This apparatus was completed by Messrs. Lowell & Dunmore approximately the end of December, 1923, and is the same set that was identified by Mr. Lewis and heretofore marked Plaintiffs' Exhibit A for Identifica-

tion. The set as completed operated satisfactorily including its assembly of three stages of radio frequency amplification, an electron tube detector and two stages of audio frequency amplification and supply of the alternating current and eliminated the hum and it impressed me considerably. Messrs. Lowell & Dunmore asked if I might know who would be interested in the manufacture of such equipment, and I gave them many names. In the course of the next few months representatives of various manufacturers visited Mr. Dunmore's laboratory or the inventors exhibited the set——

By the Court:

Q. 32. Do you get the information from being there when they called or they telling you?

A. I was there.

By Mr. Edwards:

Mr. Brady: To my own knowledge I recall particularly a demonstration at Mr. Dunmore's laboratory to Mr. Powel Crosley and Mr. George Lewis as occurring in the spring of 1924. This apparatus was operated and received broadcast music. The set operated from the lighting circuit without disturbance from hum and with satisfactory signal. The demonstration was in the spring of 1924. The date is May, 1924.

This particular set was completed about December, 1923, and demonstrated throughout the spring of 1924.

The Crosley demonstration was in the spring of 1924, instead of 1923, in May of 1924. There were a number of other demonstrations of this apparatus. I recall a demonstration to the Brandes Laboratories, and one made to the Boonton Rubber Company.

There were others. There were a considerable number. The set created great interest. I remember the Timmons Radio Products Corporation, the Pathe Phonograph & Radio Corporation, the Wired Radio Company and the Freed-Eisemann Radio Corporation, and as a result of one of these demonstrations I recall the request from Mr. Joseph D. R. Freed of the Freed-Eisemann Corporation to have Messrs. Lowell and Dunmore convert one of the standard Freed-Eisemann neutro-

dynes, then popular for battery operation, for operation from the alternating current lighting circuit.

My connection with the Freed-Eisemann matter was merely to state to Joseph D. R. Freed in person that if he cared to have such a conversion made he must supply Messrs. Lowell and Dunmore the necessary apparatus.

That apparatus was supplied by Mr. Freed and Messrs. Lowell and Dunmore set about prior to June, 1924, to convert this apparatus. It was so converted and I recall in June, 1924, Mr. Freed came to Washington to see how this set operated. The apparatus is here and I can identify it.

The apparatus com-rises a neutrodyne of two stages of radio frequency amplification, an electron tube detector and two stages of audio frequency amplification with circuit rewired to operate with the alternating current lighting circuit.

As a part of this apparatus there was constructed by Messrs. Lowell and Dunmore a power supply system including a power transformer with a rectifier unit, a filter system and circuit terminals for connecting the unit with the Freed-Eisemann neutrodyne for operating the receiver from the alternating current circuit.

MR. EDWARDS: I will ask to have the two sets marked for identification as Plaintiffs' Exhibit B, comprising the unit and the receiver marked Freed-Eisemann.

(Received and marked respectively "Plaintiffs' Exhibits B and B-1 for Identification.")

MR. BRADY: I was present at the demonstration on June 21, 1924, at which Mr. Freed was present. He came from New York especially to hear this set work.

There were numbers of licenses granted under these patents, as I recall. The Dubilier Condenser Corporation obtained a license for the manufacture of their Super Ducon. The Timmons Radio Products Corporation obtained a license, also the Fansteel Products Company of Chicago, The Grigsby-Grunow-Hinds Corporation, the Willard Storage Battery Company, the Elkon Works, Incorporated, the Argus Radio Corporation, the Brandes

Products Corporation, the Briggs-Stratton Corporation of Milwaukee, Wisconsin, and probably others of which I have no knowledge, and can not recall at this time. These instruments were in writing.

Toward manufacturing or making the device of the relay patent, the following was done. The Morkrum Company, manufacturers of printing telegraph apparatus, acquired a license from Mr. Dunmore for the manufacture of apparatus under the Dunmore patent for use in the operation of automatic printers by line wire or radio. Numbers of these relays were produced.

CROSS-EXAMINATION BY MR. BARUS:

MR. BRADY: My experience, prior to the time that I became solicitor for Lowell and Dunmore in connection with the filing of the applications for the patents in suit was as follows: I had been an Ensign in the Navy during the war, and opened my office for the practice of patents immediately following the war. Mr. Lowell had come to me in a number of instances for the soliciting of other patents, and in that way he apparently had contact with me with this present invention, and when it was produced, sought my services again.

My connection with the Radio Instrument Company was that they had come to my office a few times for the soliciting of patents, that is all. I had absolutely no other connection.

The people connected with the Radio Instrument Company were, as I remember, Mr. Brent Daniel, their president, and a number of members of their staff, including H. A. Snow. Mr. Snow, by the way, was assistant to Mr. Lowell, when Mr. Lowell wired the apparatus which I have identified. There was a Colonel Abadie associated with the company, and I am sure numerous people that I do not recall at the moment.

Probably the first time that I made any attempt to interest others in the exploitation of the alleged inventions under these Lowell & Dunmore patents, or any of them, was the mere sending of a copy of the patent to Mr. Carlson, that was in May, 1923, immediately upon issue. There was really a curiosity in me to see this apparatus developed, and I sent it to Mr. Carlson, thinking probably he had connections by which it might be done.

I recall no attempt by me to interest any one in this set at an earlier date than that.

Mr. Lowell and Mr. Dunmore told me of their activity at the Radio Instrument Company, and throughout the process of work I received reports from Mr. Lowell of the progress of his work.

I first saw the set, Plaintiffs' Exhibit A for Identification in the Christmas holidays of December, 1923, at Mr. Dunmore's Laboratory, in his home. The circumstances surrounding the demonstration were that as attorney for Messrs. Lowell & Dunmore, I was invited to Mr. Dunmore's residence to hear the set in operation, as he thought he had quite an achievement. I therefore attended the demonstration and listened to the operation.

When I saw this set in operation it had an electron tube detector, an N tube. An N tube is a special type of tube developed by the Western Electric Company which has a low current consumption filament. The type of tube is somewhat popularly known as the peanut type.

There were other peanut tubes in it beside the detector. There were three stages of radio frequency amplification, all of which were N tubes operating from the alternating current lighting source. The voltage requirement for the filament of the N tube was, I believe, about 1.6 volts. The other tubes in the set when I saw it, were two UV-201-A tubes, used for audio frequency amplification, connected as a 2-stage audio frequency amplifier following the electron tube detector. There was also a rectifier tube. This rectifier tube, however, was of the ordinary 3-electrode type and was either a UV-200, or a UV-201-A tube with the grid and plate electrodes connected so that the tube functioned as a 2-electrode rectifier, somewhat similar to the old Fleming valve type. It functioned as a half-wave rectifier, not a full wave rectifier. Only the one-half wave rectifier, was used.

This half-wave rectifier tube was of the UV-201-A or UV-200 type and the voltage requirement was perhaps 4.5 or 5 volts.

I am afraid I can not recall whether it was UV-200-A or UV-200, but it was of that type, of that class of tube.

Voltage was applied to the plate circuit of that rectifier tube as follows: The 110-volt A. C. lighting circuit supplied a transformer. The transformer had several secondary windings, one secondary winding having a step-up ratio, so that the primary winding supplied a voltage to the rectifier in excess of 110 volts. That is as close as I can answer your question.

As to how much in excess of 110 volts, the voltage supplied to the rectifier tube was, I should say it was perhaps 350 volts.

There were many devices to filter the rectified current supplied by the rectifier tube. There were condensers, reactances, resistances shunted by condensers, capacities disposed in their proper position in the circuits for accomplishing that function.

Starting nearest to the rectifier tube, the first device was in the form of the condenser, across the output of the rectifier.

I cannot testify as to what was the capacity of that condenser. As to the values, I can not testify.

The next devices following along from the rectifier tube were reactances in series with the condenser.

So far as I can recall there was perhaps one reactance in each side of the circuit.

The next device was a chain through another condenser. I might say that my memory does now seem to bring back that the capacity of that condenser was six microfarad.

The next device, I believe, was a further reactance in series in the plate system of all the tubes. I do not know the constants of that device. I am not certain it was there. I am trying to recall it the best I can. I think it was a winding of an audio frequency transformer, the secondary of which had been burned out and the primary was used as the reactance in that circuit. As near as I can recall that device was in series with the plate circuits of all of the tubes.

The next device to which I refer as a filtering device was in the separate systems, the audio frequency ampli-

fier, the radio frequency amplifier and the detector tube, there were separate filtering devices.

Continuing to proceed with the plate circuit. I do not recall the filtering device in circuit with the plate circuit of the audio frequency tubes next in line to the inductance of which I last spoke or any other element specifically in that circuit.

With reference to the plate circuit of the radio frequency tubes, I do not recall any other device in that plate circuit.

With reference to the plate circuit of the detector tube, I recall no particular filter device in that plate circuit. That detector tube was a special tube.

So that so far as the plate circuits of this device are concerned, the filtering devices were first a condenser in shunt; next an inductance in series; next a condenser in shunt; next an inductance in series, and that is all.

Referring to the grid circuit of the radio frequency tubes the source of supply for a C bias on the grids of those tubes was a special small sized C battery intended to fix the potential of the grids. This battery was perhaps eight volts in value.

Referring to the detector tube no source of voltage for C bias was applied to the detector tube; there was no battery, and no other source.

Referring to the audio frequency tubes, the source of C bias used on these audio frequency tubes was, as I recall it, that a portion of the battery previously mentioned was used for biasing the audio frequency tubes also.

Referring to the filament circuit of the radio frequency tubes, the source of supply for filament voltage of those tubes was raw alternating current obtained from a secondary winding on the power transformer supplied from the alternating current lighting socket. I might add that I recall a connection taken from a potentiometer across the filament circuit of the audio frequency amplifier tubes with a tap connection to the grids of the audio frequency amplifier tubes.

There were two potentiometers. One potentiometer was positioned across the filament circuit of the audio-frequency circuit with a separate tap connection to the grids of tubes. The first potentiometer I have reference to was in the radio frequency amplifier system, entirely separate and independent and isolated from the potentiometer in the audio frequency amplifier system.

With reference to the potentiometer across the filaments of the radio frequency amplifier tubes, on this potentiometer, the grid return of the radio frequency tubes was connected approximately the center. I often moved the potentiometer myself from one side to the other and heard hum come in and then eliminated the hum by balancing.

The plate return of the audio frequency tubes was connected to one end of the potentiometer.

I do not recall in that particular set any devices in the grid circuit of the radio frequency tubes located between the grid and its connection to the potentiometer. In other sets, I do. The C battery to which I have referred was located in that position. I had overlooked that. That is the only thing which I recall so located, except, of course, we had the usual tuned circuit, between the grid and the filament system.

With reference to the audio frequency tubes the C batter- connection was located between the grid and its return to the potentiometer.

With reference to the radio frequency circuit, the input system of the first tube was tuned by a condenser shunting an inductance. The other stages were coupled through transformer systems of the audio transformer type.

That is, the stages of radio frequency were not tuned after the input circuit in that particular set.

Returning to the audio frequency stages I do not recall any other device in the grid circuit except the C battery between the grid and its return to the potentiometer across the filament circuit except, of course, the coupling transformer within the system. The radio frequency circuit was not tuned.

Referring next to the plate circuit of the detector tube, the source of voltage supplied to that circuit was rectified alternating current from the rectifying system. It was also the same as to each of the other tubes.

With reference to the filament circuit of the detector tube, the source of voltage used to light that filament was raw alternating current obtained from the power transformer system.

I recall no device located in the filament circuit of the detector tube between the transformer and the filament.

XQ. 115. Was there any potentiometer bridged across this filament circuit such as you have spoken of in connection with the other circuits?

A. The Potentiometer used to supply the radio frequency amplifier tubes was virtually across the filament of the detector tube, independent of the potentiometer across the filaments of the audio frequency amplifier tubes.

XQ. 116. That is, there was no separate potentiometer for the detector tube?

A. In that particular set, no, but others, yes.

There was the grid leak and grid condenser located in the grid circuit of the detector tube between the grid and is return to the filament and a coupling device, coupling the detector to the output of the radio frequency amplifier. The plate circuit of the detector tube was returned to one end on the potentiometer. The output circuit used in connection with this set consisted of a Brandes table talker, loud speaker, and if you will reverse the cabinet you will see that it is a self-contained apparatus, with the speaker inside of the cabinet.

So far as I recall this speaker attached to the plate circuit of the last audio frequency tube was in series with the output circuit of the audio frequency tube in the last stage.

This speaker was not an electrodynamic loud speaker.

There was some sort of a by-pass condenser associated with the windings of the loud speaker and that by-pass condenser was in shunt with the windings of the loud

speaker. I do not know the value of that condenser. I do not know the value of the condenser used as a grid leak for the detector. I do not know the value of the resistance used as a grid leak for the detector.

I first saw the set marked Plaintiffs' Exhibit B for identification complete on June 21, 1924 at a demonstration given by Mr. Dunmore's laboratory to Joseph D. R. Freed. I was invited to that demonstration for Mr. Dunmore told me that he had succeeded in finally adjusting the apparatus for the elimination of hum and wanted to show it to me.

So far as I can recall it utilized UV 201-A tubes throughout including the tube detector.

This set is a so-called neutrodyne set and has two radio frequency stages, a detector and two audio frequency stages.

The source of plate voltage supply used on the audio frequency stages of this set was rectified alternating current obtained from a special power transformer, the primary winding of the power transformer connected to 110 volt alternating current lighting socket. There were a multiplicity of secondary windings, one of the secondary windings led to the filament of a rectifier tube and another secondary winding to the output of the rectifier for delivering rectified energy to the filter system for energizing the plate circuit of the audio frequency stages.

The rectifier tube used in this set at the time of the demonstration to which I refer was a UV-200 or UV-201-A or a tube of that class. It was a three-electrode tube with the grid and plate connected together to function as a two-electrode rectifier.

Only one rectifier tube of that type was employed.

There was of course a filter in the output of the rectifier, before getting to the plate circuit, and that filter corresponded to the filter I have already described in connection with the set of December, 1923.

The elements of the filter to which I refer are a shunt condenser, series reactance devices, another shunt condenser—I cannot definitely recall whether one or two series reactances. There was at least of course one in

series in the filter circuit between the two shunt condensers.

After passing the second shunt condenser, I do not recall a second inductance in this case. Other devices in this plate circuit before reaching the plate of the last audio stage consisted in a shunt circuit consisting of a resistance and a condenser forming a shunt device which would pass the required plate potential and provide hum eliminating means.

This device was located in series in the plate circuit of the audio frequency amplifier in all the plate circuits of the tubes. I do not know the value of the shunting condenser to which I referred, nor do I know the value of the resistance. The resistance was in series to the plate circuit supply, not in shunt. It was in series with the plate circuit supply of all the tubes.

Now, referring to the other audio frequency tube, there was an additional device in that circuit which I have not mentioned, consisting of a C biasing battery. It was not in the plate circuit, so far as I recall.

I do not remember any additional device in the plate circuit of the radio frequency tubes.

Now, referring to the grid circuits of the radio frequency tubes, I do not think there was a C battery in that circuit. There was no C battery in the grid circuit of the detector. There was a C battery in the grid circuit of the audio frequency tubes, a separate C battery in the first stage of the audio frequency, and a different C battery in the second -tage of audio frequency amplification.

The C battery for the first stage of audio frequency amplification consisted of a volt and a half. The C battery for the second stage of audio frequency amplification was approximately eight volts.

The source of filament current for the detector in the set, Plaintiffs' Exhibit B for identification, was raw alternating current obtained from the secondary winding on the transformer, which winding was entirely independent of any other secondary windings on the power transformer. There was a potentiometer bridged across

this winding with the connection from the potentiometer to the grid circuit of the detector tube.

The source of filament voltage for the radio frequency tubes in Plaintiffs' Exhibit B for identification was raw alternating current obtained from an entirely independent secondary winding on the power transformer. That filament circuit had a separate potentiometer bridged across the circuit, with a tap connection to the grid system from the potentiometer to the radio frequency amplifier tubes.

The position of the plate circuit return in the radio frequency tubes to the filament circuit was that the connection was taken from one end of the potentiometer in the filament circuit.

The position of the plate circuit return to the filament of the detector was to one end of the separate and independent potentiometer in the filament circuit of the detector tube.

I recall a condenser and the resistance in shunt connected in the grid circuit of the radio frequency tubes between the potentiometer and the grid, the resistance was in series and not in shunt. And the condenser was in shunt with the resistance, not in shunt with the grid circuit.

There were no separate resistances and shunting condensers in each grid circuit of these two tubes. The one resistance and condenser were arranged to be effective in both, so far as I recall.

The grid leak and the grid condenser and a tuned input circuit for the detector tube were located in the detector grid circuit between the grid and its return to the filament. In this case, each of the radio frequency input circuits were also tuned.

There were three separate tuned circuits, the two stages of radio frequency amplification and the tuned input to the detector.

XQ. 169. Please describe what stabilizing means, if any, was used in this set?

MR. EDWARDS: I object to that. He is asking him about stabilizing means, that is function.

THE COURT: The examination in chief was restricted to mechanism, and now of course you have to refer to function in a sense.

MR. BARUS: I think this might be simplified, your Honor, if he would show a circuit diagram of the set, and that would save a lot of time.

THE COURT: If Mr. Edwards has no objection to that; I assume he has not.

THE WITNESS: I have them available.

THE COURT: If you get a diagram, it will save us all time. Do you find one?

THE WITNESS: Yes, your Honor.

THE COURT: You are not going to offer it in evidence, but just want it marked for identification?

MR. EDWARDS: If I may be allowed to interpolate. I will ask him, and put them in evidence.

MR. BARUS: I have no objection.

RE-DIRECT EXAMINATION BY MR. EDWARDS:

MR. BRADY: I have a diagram of the set marked for identification A which I now present.

MR. EDWARDS: I offer this diagram in evidence on behalf of the plaintiff.

(Received in evidence and marked "Plaintiffs' Exhibit No. 11." *See Exhibits, Volume III, page* 77.)

THE WITNESS: Here is also a diagram for the set marked for identification Exhibit B.

MR. EDWARDS: I offer this diagram as Plaintiffs' Exhibit No. 12.

(Received in evidence and marked "Plaintiffs' Exhibit No. 12." *See Exhibits, Volume III, page* 79.)

MR. BARUS: I object to the diagrams on the ground that the parts are not identified in any way as to what they show.

THE COURT: I think that objection is not well taken. I think we may assume that these are drawn in a conventional form, unless he shows to the contrary.

RE-CROSS-EXAMINATION BY MR. BARUS:

MR. BRADY: I did not make the diagram, Plaintiffs' Exhibit No. 11, nor did I make the diagram Plaintiffs' Exhibit No. 12.

The diagram, Plaintiffs' Exhibit No. 12, the Freed-Eismann set, was drawn under the direction of Mr. Dunmore by a draughtsman. My draughtsman drew out the circuit, and I was present when it was drawn. The diagram was probably made just a week ago and it represents the set as it is today.

So far as I know it is exactly as it was when I saw it. The set has not been disturbed since the time. The set has been with Mr. Dunmore or has been in evidence in the interference situation, involving the Lowell & Dunmore patent and there has been no occasion to make any effort to disturb the circuits.

I certainly have personal knowledge since the set was offered in evidence in the interference, that no one has touched that set. That was probably four months ago.

I think that it is a fair statement that prior to that time, my personal knowledge does not reach with respect to what has been done to the set.

That same situation is not equally true with respect to the diagram, Plaintiffs' Exhibit No. 11.

That particular set has been at my mother's home for the last several years in operating condition so that I know that has not been touched. I have seen it day after day when I visited her home. Mr. Dunmore built it, with that in mind, in addition to exploiting the invention. It was taken to my mother's home probably the middle of 1924.

Since these diagrams were made, I have not personally compared them with the respective sets they purport to represent. I do not know personally whether or not they correctly represent the sets. But it is my understanding, having been drawn out by Mr. Dunmore

and directed to be drawn out by my draughtsmen, that they do.

MR. BARUS: I object to the diagrams on the ground that the witness who offered them does not know whether or not it is the correct diagram of the sets it purports to represent.

THE COURT: Plaintiffs' Exhibits Nos. 11 and 12?

MR. BARUS: Yes.

THE COURT: Do you care to be heard, Mr. Edwards? I think the objection is well taken, unless you show me something that I do not think of.

MR. EDWARDS: I think the witness has said enough to indicate what his memory is as to the sets. I should like to ask him——

THE COURT: If you want to inquire about that, you may, but as it now stands, I think the objection is well taken. You may agree to admit this set of drawings if you want to.

MR. EDWARDS: I shall ask him now a question or later I may question on this line and cure it.

MR. BARUS: I have no obpection to the diagram going in evidence, but I want them in evidence by a witness who can be examined as to what they show, and can give an answer.

RE-DIRECT-EXAMINATION BY MR. EDWARDS (Continued):

MR. BRADY: These diagrams, Plaintiffs' Exhibits Nos. 11 and 12, show the construction of these sets marked for identification Plaintiffs' Exhibits A and B to the best of my recollection, and they conform with my recollection as to the construction.

During my cross-examination, the sets have been 10 or 11 feet in front of me. During all the time of my cross-examination. I did not personally inspect these sets. My testimony during cross-examination was given from my recollection.

MR. EDWARDS: I think, your Honor, that the witness has so good a memory that few of us could equal it.

THE COURT: I agree.

MR. EDWARDS: And that would indicate his correctness as to the diagrams.

THE COURT: I agree with you as that, Mr. Edwards, but I do not know yet whether the witness has gone over this drawing now marked Plaintiffs' Exhibit No. 11, and checked it with his memory to see whether it corresponds in every detail with his recollection. He says he recalls them as he recalls having seen them in December, 1923, and June, 1924, the other one.

THE WITNESS: That is it.

MR. EDWARDS: I will ask him another question on that, if your Honor will permit.

THE COURT: All right.

Q. 194. Will you now check over these diagrams, Plaintiffs' Exhibits Nos. 11 and 12, and see if they correspond to your recollection of the way these sets were constructed at the time you saw them on the dates given in your testimony, and whether or not they embody the details as shown in the sets but shown in these drawings in conventional form?

A. In examining the circuit diagram, Plaintiffs' Exhibit No. 11, I do not find the shunt condenser around the loud speaker system which I thought I recalled as employed in the December 1923 set.

The other elements, however, appear as I remember them, so far as I see. In Plaintiffs' Exhibit No. 12 the elements correspond as I remember them with slight exceptions, and that is, I find a C battery in the detector circuit and in the audio frequency amplifier the C battery is not divided by stages. The characteristic condenser and resistance in shunt connection which I recalled in the grid circuit of the radio frequency amplifier and in the plate circuit of the audio frequency amplifier does not appear here but there are resistances disposed in other parts of the circuit. The vital arrangements as I have recalled do appear in both of the diagrams.

I will mark in pencil the condenser around the telephone in Exhibit No. 11 to which I referred and also

indicate by number the C battery in the detector circuit on Exhibit No. 12 and mark in pencil on Exhibit No. 12 the other features to which I referred and not shown in these drawings.

I will now explain the changes I have made.

In No. 11 I believe my previous testimony stated that there was a C battery in the radio frequency amplifier grid circuit, as I have indicated in ink on the diagram at the place marked G. I believe I also stated that there was a reactance in series in the plate circuit at the point marked R and I further stated that there was a by-pass condenser at the point marked T. I believe all of the other statements are accurate.

In Exhibit 12 I have indicated the shunt condenser and resistance at the point marked S in the grid circuit of the radio frequency amplifier. I have cancelled the C battery in the detector circuit at the point marked Z. I have added a C battery in the second stage of audio frequency amplification as shown at Y and I have shown the condenser and shunt resistance in the output circuit of the radio frequency amplifier at the point marked Z. I believe the other points are accurate. I started to make a correction in the ground lead near the left of the diagram but no correction is necessary in accordance with my recollection.

RE-CROSS-EXAMINATION BY MR. BARUS:

XQ. 197. Mr. Brady, will you please identify on the diagram the location of the battery which is in this set, Plaintiffs' Exhibit B, and which is marked Burgess Radio A.

A. That is a C battery shown in the audio frequency amplifier in Exhibit 12 and marked on Exhibit 12 at Q.

XQ. 198. In the diagram at Q several cells are indicated, whereas the battery seems to be only one cell. Can you explain that, please.

A. As I recall an additional cell which is also shown in the set was connected in series. In fact, you will observe the wire leading to the additional cell connecting in series the dry battery. There are two dry cells in series.

XQ. 199. The other dry cell appears to be of the usual C battery shape. With reference to that battery, since it seems to be the only other battery, will you please state what is the device shown on Exhibit 12 at the point marked "X"?

A. I find on closer inspection that the round battery is the battery at the point X and the other C battery is the C battery at the point marked Q, and these are not connected in series except to the ground connection. The diagram is correct, at the point marked Q in showing several cells since the small C battery is made up of a multiplicity of units. And it is correct in showing it at the point marked X a single cell.

Referring to the diagram Exhibit 11, in the right-hand end at the point marked M is a condenser shunted by a resistance. I can not state the value of that condenser and of that resistance.

I have marked my original exhibit with M so that that can be identified.

MR. BARUS: I think it would save a good deal of time in cross-examining this witness about this drawing if we would look it over and see if we understand it or not. My experts told me it would take some time to trace that out.

THE COURT: Then it is agreeable to both sides to have this witness withdrawn and replaced by another witness on behalf of the plaintiff.

MR. BRADY RECALLED AND CROSS-EXAMINATION BY MR. BARUS RESUMED:

MR. BRADY: The detector in the set which I testified I saw in the Bureau of Standards in 1922 was a crystal detector. That set had C batteries used to bias the grids of both the radio frequency and audio frequency tubes. I do not recall that that set did not have in it any inductance—such as inductance marked 40 in the drawing of Patent No. 1,455,141.

MR. EDWARDS: I understand this is not asking him if there is any part corresponding to that function but merely whether there was a device or coil in that particular circuit at that place.

MR. BARUS: That is it.

MR. BRADY: I saw some of the relays made by the Morkrum Company to which I referred as a licensee under the Dunmore patent. The relays which I saw were operated from alternating current. There were also relays operated from batteries.

XQ. 209. In your testimony respecting Plaintiffs' Exhibit A for identification (now Plaintiffs' Exhibit No. 48), you stated in XQ. 76 that there were two reactances between the two condensers. The diagram, Plaintiffs' Exhibit No. 11, shows only one. Which is correct?

A. Since testifying I have tried to recall the exact situation and in making a search I have found a diagram made at the exact time the set marked for identification A was made. The reason I know it was made at the same time is that the sheet is covered with the same stain which was used to stain that box red and in referring to the diagram I find one reactance.

In comparing that original diagram made at the time of December, 1923, set with Exhibit 11 there appears to be one reactance in the diagram in Exhibit 11 and therefore a correct statement is that there was one reactance in the filter circuit between the two shunt condensers. I may say that the pencil diagram made at the time of the building of the December, 1923 set is made in Mr. Dunmore's handwriting which I identify but I note thereon at least three marks which I identify in my handwriting, one being "three-quarters megohms" and another "three-quarter megohms," and still another marking "three-quarter megohms," being the coupling resistance between the tubes. I checked this diagram at the time to see if it was correct.

XQ. 211. In answer to XQ. 92 you said there was no grid bias on the detector tube of Exhibit A. In Exhibit 11 as originally submitted the detector has a grid return to the top connection of a potentiometer. As amended by you the grid of this tube is biased by a battery marked C. Which is correct?

A. Really what I meant was that there was no extra battery so far as I could recall for the purpose of biasing the grid of the detector tube. The return to the potentiometer is the correct way in which this circuit is wired and was wired originally.

The grid of the third tube from the left in Plaintiffs' Exhibit No. 11 is connected to one side of the potentiometer across the filament. This does not accord with my recollection of Exhibit A.

I find on inspection that that connection should be to the mid point of the potentiometer—in accordance with my recollection—and that appears in the original diagram which I have found. So Exhibit 11 is wrong in that respect.

XQ. 218. You testified that the plate circuit was returned to the leg of the filament as in the Lowell & Dunmore patent in suit, whereas diagram, Plaintiff's Exhibit No. 11, shows it returns to the mid-point of the potentiometer. Which is right?

A. The connection to the mid point appears to be right.

XQ. 219. So that in that respect it is not like the drawing of the patent?

A. (Perusing patent.) You are right.

XQ. 220. You stated that Exhibit B for identification used 201-A type tubes through (XQ. 131). There is now one tube in one of the sockets. Is this the same type of tube that was used in that socket when you saw the set in 1924?

A. Yes. This is the same type of tube, but it appears to be the WX-12. I recall that in this detector tube socket, at various times the UV-201-A tube was used and the WX-12, which was similar to the WD11 of an earlier date. The particular beauty of this tube was, as I recall it, the low voltage requirement for the filament and the fact that the detector tube in itself operated for the elimination of hum, so that the detector system would be a hum elimination system.

XQ. 221. Now, do you know whether the set was operated with tubes of the type of WX-12, in each socket or only in the detector socket?

A. Only in the detector socket.

XQ. 222. Do you know whether this WX tube was used in the detector socket at the time of the demonstration to Mr. Freed?

A. Yes, and I do recall that the tubes were changed in the socket to determine the different degree of hum and the UV-201-A tube was used in the detector socket, and it was shown with this type of WX-12 tube, that the degree of hum would be reduced by using a particular type of tube in the detector socket.

XQ. 223. The hum was not eliminated, it was only reduced?

A. To all practical purposes the hum was eliminated as far as practical purposes were concerned. I recall the Western Electric loudspeaker of the horn type, used in the June 21, 1924 demonstration to Mr. Freed, and in that speaker good quality reception came in, with no noticeable disturbance and disagreeable disturbance from the hum.

XQ. 224. In XQs. 144 and 145 and 149, you stated that the condenser and resistance there referred to were in the plate circuit of all of the tubes. As you corrected Exhibit 12, you showed such condenser and resistance only in the plate circuit of the last audio frequency tubes. Which is correct?

A. Will you let me have your Exhibit No. 12, please? My correction should have been to dispose the shunting condenser and resistance in the lead immediately adjacent and parallel to the lead in it which now appears, and I will be glad to make the proper correction in red, so that the device including the shunt condenser and resistance is in the common lead to the plate return circuit. I have marked the correct insertion by the letter O.

XQ. 225. As you first corrected it, it was located in the same position as in the drawing of patent No. 1,455,141. As you have now corrected it, it is not so located; is that right?

XQ. 226. In Exhibit B (now Plaintiffs' Exhibits 49 and 49-A), according to your testimony, XQs. 159 and 160, the plate circuit returns were made to one side of the potentiometer; as shown in Plaintiffs' Exhibit No. 12, the plate returns are connected to the mid-point tap on the potentiometer. Which is correct?

A. The correct connection is to the mid-point taps on the potentiometer. In that respect the connection differs

from the connection of the plate return as shown in the drawing of Patent No. 1,455,141.

XQ. 228. In your answer to Q. 194, you stated "That there are resistances disposed in other parts of the circuit," of Plaintiffs' Exhibit No. 12. Please point them out and mark them.

A. I have the original. The resistances to which I had reference are shown near the center of the diagram in Plaintiffs' Exhibit No. 12, which I now mark by the letters A and B in red, and also the resistances shown at C and D in red. I might point out in the neutrodyne receiver the position of the resistances A and B. These resistances are variable in character and were placed behind the front panel of the set, and on opposite sides of the center control condenser.

I am still the patent attorney for Lowell and Dunmore. I have no contingent interest whatever in the outcome of this litigation.

I have not the slightest present or contingent interest in the outcome of the interferences in which certain claims of this patent are involved and to which I referred in XQ. 179.

I did not attempt directly to interest the Dubilier Company in the Dunmore and Lowell patents. The way in which that situation developed, I do recall, however. I have a clear recollection of those events to the extent that condensers were necessary and the Dubilier Company being a source of supply.

XQ. 235. Do you know whether the Dubilier Company ever made any alternating current set?

A. Yes, sir.

XQ. 236. Did they or did they not?

A. The Dubilier Company manufactured the Super Ducon, which was an apparatus for eliminating batteries and operating a radio receiver by supplying the B potential for the election tubes in the radio receiver. So far as I know it was a B eliminator. In so far as I know that is the only type of apparatus for use with alternating current which they made, radio apparatus.

In the Navy during the war, I was in charge of purchases and shipments to ship and store stations of radio apparatus for operation for war purposes. The Navy bought a considerable amount of apparatus from different manufacturers and I had to see that that apparatus was on hand when required.

MR. EDWARDS: *I will offer in evidence the diagram* produced by the witness during his cross-examination.

MR. BARUS: I have no other objection.

(Received in evidence and marked "Plaintiffs' Exhibit No. 50." *See Exhibits, Volume III, page 187.*)

RE-DIRECT EXAMINATION BY MR. EDWARDS:

MR. BRADY: I was asked during the direct examination if I could produce a copy of the license with the Radio Instrument Company. I have found a copy and produce the same.

MR. EDWARDS: I will offer in evidence the copy produced by the witness of the license to the Radio Instrument Company.

(Received in evidence and marked "Plaintiffs' Exhibit No. 51." *See Exhibits, Volume III, page 189.*)

I have a letter from the Westinghouse Company dated July 23, 1923, at which time this patent was called to the attention of the Westinghouse Electric & Manufacturing Company together with the reply of the company under date of July 31, 1923, which I produce.

MR. EDWARDS: I will offer these copies in evidence.

(Received in evidence and marked "Plaintiffs' Exhibits Nos. 52 and 52-A." *See Exhibits, Volume III, pages 193-195.*)

THE COURT: The letters are admitted without the penciled notes thereon. The General Electric Company's letter. The General Electric Company letter Exhibit No. 9 of yesterday is likewise admitted without the notes penciled thereon.

ROY E. SWEENEY.

ROY E. SWEENEY, called as a witness on behalf of the plaintiff, being duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. EDWARDS:

MR. SWEENEY: I am secretary and treasurer of the Dubilier Condenser Corporation. I have a list of the licenses granted under one or more of the patents in suit and a memorandum of the dates of these licenses and the amounts of money received from the licenses under them.

MR. EDWARDS: I may say to your Honor that Mr. Neave and I will agree on putting in either the licenses themselves or a statement concerning them later.

MR. SWEENEY: The royalties received from our licensees as shown by our records are as follows: During 1926, we received from the Argus Radio Corporation, contract dated June 8, 1926, $1000.

We have a contract with the Elkon Works dated September 15, 1926, from whom we received $1000.

We have a contract with the Fansteel Products Company July 15, 1926 and we have received $5000.

During the year 1927 we have received from Briggs & Stratton, contract dated January 1, 1928, the sum of $6000. Fansteel Products Company paid us the second year's royalties of $5,000. Grigsby, Grunow & Hinds Company under our contract dated February 16, 1927, that first contract being on our Patent No. 1,455,141, and our contract dated October 4, 1927 on our Patent No. 1,635,117, paid the sum of $5000.

We have a contract with the Willard Storage Battery Company dated January 19, 1927 from which we received $5000.

During 1928 we received $835 in royalties from the Elkon Works, $5000 from the Fansteel Products Company $7500 from Grigsby, Grunow, Hinds Company, on the previous mentioned contract, also $1875 from Grigsby, Grunow, Hinds Company on a contract dated November 18, 1927, covering our Patent No. 1,606,212, and $7500

from the Willard Storage Battery Company from our contract mentioned previously.

In addition to the ones just mentioned we have as licensees the Brandes Products Corporation and the Philadelphia Storage Battery Company. I have no personal knowledge as to what royalties they paid.

I do not know what royalties the Morkrum Company have paid. There are none paid to the Dubilier Company direct. The grand total of the royalties received by us are $50,710.

CROSS-EXAMINATION BY MR. BARUS:

MR. SWEENEY: With reference to the license of the Philadelphia Storage Battery Company, I have no definite knowledge what device that company made if any under the license.

With reference to the license with Elkon Works, I have no knowledge of what that company made under the license if anything.

With reference to the license to the Morkrum Company, I do not know what device that company made if any under the license.

With reference to the license to Argus Radio Corporation, I do not know what device if any that corporation has made under the license.

In the case of the Fansteel Company, I do not know what device that company made under the license. I am not familiar with the details of their product.

With reference to the Grigsby, Grunow, Hinds Company, I do not know what that company made under the license.

With reference to the Brandes Products Company license, I have no knowledge of what that company made under the license.

With reference to the Briggs & Stratton Company license, I do not know what that company made.

With reference to the Willard Storage Battery Company license, I do not know what that company made.

I have no definite knowledge whether the payment made under the Philadelphia Storage Battery license was in excess of a minimum royalty provision.

The Elkon Works have been paying royalties on the units produced.

And with reference to the Argus Radio Corporation, they also pay on the number of units produced.

In the case of the Argus the amount paid is the original amount paid on the execution of the agreement. No further payments have been made.

As to the Elkon Works there have been further payments on Elkon since the execution of the agreement. I do not know whether the amount paid by Elkon is in excess of the minimum amount provided by the contract.

The Fansteel Products Company have paid the amount specified in their contract.

XQ. 22. Was that payment on devices produced or was it to be paid anyway?

A. That is the sum called for in the contract.

XQ. 23. Regardless of how many devices were produced under the contract?

A. I cannot state definitely.

With reference to the Grigsby, Grunow, Hinds license, the payments made under that license were in excess of the minimum royalty provision in the license.

We have three contracts with Grigsby, Grunow, Hinds Company, each covering a separate patent and in my previous testimony I gave the patent numbers. If you wish them again they are our contract dated February 16, 1927, covers Patent No. 1,455,141, and our contract dated October 4, 1927, covers Patent No. 1,635,117 and our contract dated November 18, 1927, covers Patent No. 1,606,212.

I do not know whether the amount paid by the Brandes Products Company was in excess of the minimum provision of the contract since I have no definite knowledge as to what was paid direct to the inventors.

The Briggs, Stratton Company paid the original amount required by the contract on the execution of the agreement with them. I understand they later went out of that line of business. I do not believe it made any difference under the contract with Briggs & Stratton Company whether they made any more devices or not, but I am not sure of that.

With reference to the Willard Storage Battery Company license, the amount paid under that license exceeded the minimum provision.

I know that the several licensees to whom I have referred, paid the proper amount of royalty, because the licensees under our contracts have paid the amounts stipulated in the contract. In one or two cases, however, the Argus Radio Corporation and the Elkon Works, these amounts are paid based on the units produced, and we have a report from these companies showing the number of units produced, together with their check for the royalty.

I do not have the information to show what were those units in the case of the Elkton Company and the Argus Radio Company.

MR. EDWARDS: I will offer in evidence the correspondence file between Mr. Brady and the Westinghouse Electric & Manufacturing Company and the Radio Corporation. I understand that it is admitted by counsel that the letters were written on or about the dates borne by them, by the respective parties whose names are signed to the correspondence. I may say this is upon the point of showing notice to the defendants of the patents in suit.

MR. BARUS: I do not believe it is worth objecting to.

THE COURT: You agree to the suggestion of Mr. Edward and the documents are admitted.

(Received in evidence and marked "Plaintiffs' Exhibits Nos. 13, 13-A to 13-F." *See Exhibits, Volume III; pages 81, 82, 83, 84, 85, 86, 87.*)

JOSEPH D. R. FREED.

JOSEPH D. R. FREED, called as a witness on behalf of the plaintiff being duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. EDWARDS:

MR. FREED: My address is 912 Fifth Avenue, New York City, and I am president of the Freed-Eisemann Radio Corporation. The business of that corporation is manufacturing of radio apparatus. It has been in business since about 1921. I was the founder of that business and have been connected with it since its inception.

In 1921 or 1922 there were broadcasting stations in operation. As I recall the first broadcasting stations started operation in the fall of 1921.

I remember station KDKA of Pittsburgh and station WJZ, which was then located at Newark, New Jersey.

I cannot give you an accurate figure of the volume or extent of business done by the Freed-Eisemann Company, but I should judge that during 1921 and 1922 we made at least 50,000 radio sets.

There were other manufacturers manufacturing radio receiving sets at that time. None of those sets were operated from alternating current, as I recall.

The first sets we made were so-called crystal detector sets which required no battery of any kind and after that we brought out radio sets which operated from storage batteries and dry batteries.

Concerning the size and standing of the Freed-Eisemann Company today, I should judge that we do about three and a half to four million dollars worth of business annually. I do not know just how we run in size with the other radio manufacturers.

It has been a part of my work to keep in touch with the new types of receiving sets or apparatus put upon the market or brought out in any way by other people.

I first heard of an alternating current operated radio receiver during the early part of 1924, if my memory serves me, the spring of 1924.

The set which was called to my attention was one which had been made by Mr. Dunmore, who was at that time with the Bureau of Standards.

I did the following about it: Mr. Brady, who at that time was one of our patent lawyers, called my attention to the fact that one of his friends had built a radio set which would operate from the alternating current supply. Mr. Brady told me about it and asked me whether I was sufficiently interested in hearing a demonstration of this set. I told him I was. Mr. Brady said he would arrange for an appointment at which time I could see and hear the radio set. I made such an appointment and saw the set in Mr. Dunmore's home and I fix the time as sometime in June, 1924.

Looking at the sets before me on the chairs, I can identify among those sets the one similar to, or the same set, as shown me.

This is the set marked for identification Plaintiffs' Exhibit B, which I believe I saw and heard at Mr. Dunmore's home.

The operation of that set at that time was such as to impress me with the value of a device of that kind. I told Mr. Dunmore that I thought the demonstration was a satisfactory one considering the fact that he had just used the materials which were available and had not really had a chance to do a thorough engineering development job, and I suggested that he send the radio set up to the factory where I would have an opportunity to make further tests on the set in our own premises.

Personally, after that, I went abroad in the middle of July, 1924, after I had asked Mr. Dunmore to send the set up to the factory. Upon my return I learned from my partner that Mr. Dunmore had sent the set up to the factory but that Mr. Brady or Mr. Dunmore wanted the set for some other work and had requested its return. I was told by Mr. Eisemann that he had returned the set either to Mr. Lowell or Mr. Dunmore.

My company did not take up the manufacture of that set at that time for the reason that we investigated the patent situation covering the broadcast receivers in general and we thought at that time that we might run into

some complications with patents covering filter circuits and C bias circuits and we felt that we would rather not take up the manufacture of that alternating current set at that time.

CROSS-EXAMINATION BY MR. BARUS:

MR. FREED: Our company began to make sets of the type of Exhibit B for Identification in the summer of 1923, about that time. That is, of course, such sets without alternating current operation. The generic name for that type of circuit used in that set is tuned radio-frequency. That particular type is often referred to as a neutrodyne.

I believe ours was one of the first neutrodyne sets, but I can not say with certainty. I have no present recollection of any tuned radio-frequency set that was on the market before our set.

My opinion is the tuned radio-frequency set had such great development was because of the application of the neutrodyne principle.

There was no substantial demand on the market for so-called radio frequency sets in which the various radio frequency stages were connected by untuned transformer circuits.

The reason for that was the number of broadcasting stations was increasing very rapidly and the demand was for a radio set which could easily separate the broadcasting stations.

During the year 1923, there were some crystal sets on the market. There were some regenerative action tube receivers. There was an increasing number of neutrodyne receivers coming on the market at that time.

The situation in 1924 was, as I recall, the regenerative receivers were losing their vogue, and the demand was more and more for the tuned radio frequency receivers of the neutrodyne type.

As to what was the first alternating current operated receiving set on the market that came to my attention, that is, the first one which was sold and advertised to the public, I will have to think for a few moments. I think

I once saw a set advertised made by the Argus Company; I believe they had an alternating current set.

I do not know what became of that set. I think the company is still doing a small business. It did not make any substantial impression on the market.

The first alternating current operated set that made any substantial impression on the market, I believe was one of the sets put out by the Radio Corporation of America, as I recall at this time.

I do not just recall the model number. I think it was a tuned radio frequency receiver for alternating current operation. I am not sure of the number.

As I recall it came out in 1926. It may be 1927. Either the end of 1926 or the beginning of 1927.

I believe a super-heterodyne set came out sooner. I believe there was a super-heterodyne set brought out by the Radio Corporation of America, in which dry battery tubes were used. I think that preceded the tuned frequency radio set.

The filaments in that set were not excited by alternating current in the sense of raw alternating current. As I recall it, they were excited by direct current.

The quality of reproduction obtained from a magnetic type of loudspeaker is not dependent to a considerable extent upon the power which is available to operate the speaker.

I would say the volume output of the speaker is dependent on the power, but not the quality.

The reason why so-called power amplifier tubes came into use, in my opinion, I think it was a natural development. People wanted to get louder volume from their radio sets, and the natural thing to do was to deliver a vacuum tube that would distribute a larger output to the loud speaker. That had nothing to do with quality, as well as power, only incidentally. A well-designed speaker will deliver a good quality whether the signal is loud or weak.

With reference to the so-called power tube, there have been power tubes made and used for several years; even

before broadcasting, those tubes were used in various telephone repeater circuits and in long distance lines. They have been in use for some time.

There are two generally accepted types of power tubes. There is a so-called 171 type which is a low-power amplifier tube, and the 210 or 250 type tube. I believe that the 171 type power amplifier tube was brought out some time in 1926, as I recall. That is a low-power amplifier tube. The first neutrodyne sets we built we did not use power tubes because they were not available at the time.

We started to use the 171 type tube just as soon as they were put on the market. I think we were one of the first companies to use them. I do not recall the exact date.

We did, in fact, increase the voltage supply for those power tubes as compared with the voltage supply for the other tubes, and that was the practice with respect to power tubes in all the sets that I know of where it was used.

We are making alternating current operated receiving sets today. We have been making them since about May, 1927.

We have not a license from the plaintiffs in this case. We are making today several types of sets.

Concerning the alternating current receiving set, the most popular set which we make utilizes the type CX-326, C-327, C-380 and C-371A tubes or the equivalent Radio Corporation tubes. That is our more popular type set. Those are all so-called alternating current tubes.

RE-DIRECT EXAMINATION BY MR. EDWARDS:

MR. FREED: We had some discussion with the Dubilier Company regarding the possibility of license under these Lowell & Dunmore patents. We are not a licensee at the present time.

I recall that the Western Electric Company had a power amplifier with power tubes as early as about 1927.

RDQ. 84. You were asked something about the first set put upon the market operated by alternating current which made a substantial impression upon the art, and I believe you at that time mentioned the Radio Corporation

set. In order to get some idea as to what was meant by an impression, in what way you meant making a substantial impression, I would like to ask you whether that means in advertising or sales or volume or quality of instrument or what? What was it that made this impression?

A. A large amount of money was spent in advertising this new type of set and that created a widespread interest in the radio trade itself. I do not believe that the average consumer was as much impressed as was the radio trade. The reason for it is that the set was a very expensive set and it had not been entirely perfected and it still had certain imperfections, and so the consumers generally were not as greatly impressed as was the radio trade because it was something new to them. It was a set that they had never seen before.

By the Court:

Q 85. Do you happen to know whether that is the Radiola 28?

A. I believe that is the number.

By Mr. Edwards:

Mr. Freed: Up to that time, the Radio Corporation confined itself to direct current operated sets, so far as I know, that is, so far as the general market was concerned.

According to the information or knowledge I have, the Radio Corporation has very large distribution for its set. The volume in the direct current sets from 1921 up to 1925, the latter part of 1925, the time the alternating current sets came out was, that practically all of the sets sold up to that time were storage battery operated types.

The volume of business of the Radio Corporation in receiving sets was a very large business.

Mr. Edwards: That is all.

(Witness excused.)

Mr. Edwards: I will offer in evidence a photograph of the receiving set which was marked for identification "Plaintiffs' Exhibit B." The photograph I think speaks for itself.

(Received in evidence and marked "Plaintiffs' Exhibit No. 46." *See Exhibits, Volume III, page 181.*)

MR. EDWARDS: I will offer in evidence a photograph of the receiving set which has been referred to as the portable set and marked for identification as "Plaintiffs' Exhibit A." This photograph also I believe speaks for itself.

(Received in evidence and marked "Plaintiffs' Exhibit No. 47." *See Exhibits, Volume III, page 183.*)

MR. EDWARDS: I will also offer in evidence the receiving set, which was marked for identification "Plaintiffs' Exhibit A."

(Received in evidence and marked "Plaintiffs' Exhibit No. 48.")

MR. EDWARDS: And also the receiving set, which was marked for identification "Plaintiffs' Exhibit B," which includes two portions, the receiving set and the rectifying unit.

(Received in evidence and marked "Plaintiffs' Exhibits Nos. 49 and 49-A.")

ALEXANDER ERNEST REOCH.

ALEXANDER ERNEST REOCH, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. BARUS:

MR. REOCH: My residence is East Orange, New Jersey; my occupation is that of a radio engineer, at present in the position of manager of the Production and Service Department of the Radio Corporation of America.

I have held that position since January 1, 1926.

My previous experience in radio was as follows: From 1902 to 1905 as a radio engineer in the employ of the British Marconi Company. From 1905 to 1917 as the radio engineer in the employ of the Marconi Company of Canada, part of which time I acted as chief engineer

of that company. From 1917 to 1919 as a radio engineer in the employ of the American Marconi Company. From 1919 to the present date I have been in the employ of the Radio Corporation.

Prior to January 1, 1926, I was engaged in the communications branch of the business, latterly as assistant chief communication engineer.

My experience has covered design, construction, installation, and operation of radio telegraph and radio telephone equipment, the former in many parts of the world. I have also had some experience in the manufacture of the apparatus for these stations.

When I assumed my present position as manager of the Production and Service Department on January 1, 1926, the following radio sets were then being marketed by the Radio Corporation:

Beginning with the smallest set there was a Radiola 3-A. This was a set consisting of regenerative detector and two stages of audio-frequency amplification, the last of which two stages used two tubes.

There was a Radiola 20 which was a tuned radio-frequency type of receiver using two stages of radio-frequency amplification, one detector and two stages of audio-frequency amplification.

There was a Radiola 25 which was a six-tube superheterodyne set.

There was a Radiola 28 which was an eight-tube superheterodyne set. There was 104 loud speaker which was an electrodynamic type of loud speaker equipped also in the same unit with the power amplifier and a rectifier and filter system for supplying power to the loud speaker and the power amplifier from the house alternating current supply.

There was 100 loud speaker which was a plain magnetic type of loud speaker. There was a unirectron which was a rectifier and filter system supplying a single stage of power amplification which could be driven from the house alternating current lighting circuit and could be used with any set that would drive a magnetic type of loud speaker.

There was a duo-rectron which was a rectifier and filter system used to convert the alternating current supply to a supply suitable for the B circuits and it could be used with any set and was generally known as a B eliminator.

In addition to which there was a Radiola 30, which was substantially a combination of Radiola 28 and the power portion of the 104 loud speaker but with a different type of loud speaker to that which was used in the 104. The Radiola 30 used the magnetic type of loud speaker. This set could be used directly from the alternating current house lighting circuit.

The Radiola 25 and 28 were designed for battery operation, but they could be used in conjunction with the 104 loud speaker so that they would take their power supply from the house lighting circuit instead of from batteries. When used as battery sets the tubes had their filaments connected in parallel and when used for complete alternating current operation subsidiary equipment had to be used with the set to change the parallel system of connection of the filaments into a series system of connection.

When I assumed my position on January 1, 1926, I had occasion to look into the question of how many of these speakers had been sold prior to that date. Also as to how many Radiola 25 and 28 for battery operation had been sold prior to that date, and also as to how many alternating current packages for converting the 25 and 28 super-heterodyne for use with the 104 loud speaker had been sold prior to that date.

I can state those figures approximately as follows: 104 loud speakers, approximately 5000. Radiola 25, approximately 50,000. Radiola 28, approximately 30,000. Subsidiary equipment for changing the Radiola 25 for complete alternating current operation about 200. Subsidiary equipment for changing Radiola 28 for complete alternating current operation about 400.

The largest number of sets in demand by the public on January 1, 1926, were of the tuned radio-frequency type.

The majority were operated by means of storage batteries for the filament supply and dry batteries for the B

circuit supply. Some used dry batteries for the filament supply also but they would be the minority.

There were a number of B eliminators such as duo-rectron on the market at that time.

The type of tube which the Radiola 20 employs is the tube known as the UX-199. This was a tube that had been specifically designed for battery operation; that is, for dry battery supply to the filament. The filament was very small and required only about 6/100th of an ampere to heat it.

The same tube, the UX-199 was employed in the super-heterodynes 25 and 28. A power tube was employed in the Radiola 20. In the last audio stage UX-120 tube was used, and this tube was of somewhat similar type to the 199. It was designed for dry battery operation of the filament, but the filament required about twice the amount of current required for the filament of the UX-199 tube.

A power amplifier tube was used also in the Radiolas 25 and 28 as designed for battery operation, it was the same UX-120 tube and it was used in the output stage in both those sets.

I believe the plate voltage required for the operation of this power tube was 135 volts. That is approximately correct.

That was more voltage than was applied to the other tubes used in the Radiola 20 and in the super-heterodynes 25 and 28, as designed for battery operation.

I cannot specify exactly the voltage used on each of the tubes in the Radiola 20. The voltage would not be in excess of 90 volts, and in the case of the detector tube, I believe it was specifically low.

In the Radiola 20 there were tubes, some of the same character and some of a different character, which required different voltages to be applied to their plate circuits. The same voltage was applied to the filaments of all the tubes. The current in the filaments was different in the case of the power output tube.

In Radiolas 25 and 28, there are 199 tubes, two used as detectors, one as oscillator, the others as amplifiers, and different voltages will be used on the plate circuits for

the three different purposes, as a general rule. I should say that in no case were the voltages supplied for the 199 tubes to exceed 90 volts.

When the Radiolas 25 and 28 were adapted by the A. C. package for operation with the 104 loud speaker, the power tube in the 25 and 28 sets as they were designed for battery operation was taken out.

The power tube of the 104 loud speaker was substituted which was a very much higher power unit.

That was also true in the case of Radiola 30.

My commercial experience with Radiolas 25 and 28, adapted for operation with the 104 loud speaker was that we purchased and sold a large number of Radiola 28 for use in conjunction with the 104 loud speaker. We had considerable trouble in service with those sets, due to the complicated nature of the set and the frailty of the tubes used in the set.

I took part in practically all deliberations as to what sets should be made with regard to the latter half of the year 1926 and early in 1927, which deliberations resulted in decisions as to what sets should be made during that period.

My duties in connection with new sets consist in conferring with representatives of other departments of the Radio Corporation, and representatives from the manufacturers who will make our sets for us as to what will be the best type of set to produce at a certain time. Decisions are reached at these conferences as to what will be the sets.

Next, my duty is to secure quotations, prices, delivery dates and negotiate production schedules with manufacturers and to recommend to the executive officers of the Radio Corporation the placing of the orders for the production of these materials.

The following sets were put into production in the early spring of 1927 and in the fall of 1926.

In the fall of 1926 I do not recollect any important orders for production being placed. In the spring of 1927 orders were placed for the production of the following sets: Radiola 16, Radiola 17, Radiola 30A, Radiola 32.

My recollection is that orders were placed for the production of Radiola 17 in April, 1927.

I was not personally a member of the board or committee, or whatever it was, which decided as to what parts should be put into the Radiola 17.

That was decided by the manufacturers and the designing engineers. I understand that you do not refer to the general aspects of Radiola, namely, as to whether it should be an alternating current or a battery set.

I was a member of the committee that decided whether it should be alternating current or battery set.

Radiola 16 was a tuned radio frequency type of receiver, using three stages of radio frequency amplification, a detector stage, and two stages of audio frequency amplification. It uses five 201A and one 112 power output tube. It was a battery operated set.

The power output tube required somewhat higher voltage for the plate circuit than the other tubes and the same voltage, but somewhat higher current for the filament circuit than the other tubes.

Radiola 16 went on the market about July, 1927.

I produce a copy of the service notes showing a diagram of Radiola 16.

MR. BARUS: Defendant offers in evidence the service notes of Radiola 16.

(Received in evidence and marked "Defendant's Exhibit No. 11." *See Exhibits, Volume IV, page 675.*)

MR. REOCH: Radiola 17 went on the market about August, 1927. About 100,000 Radiola 17 sets were sold in the balance of the year 1927.

The UX-226 and UY-227 tubes were placed on the market about May, 1927. About two million UX-226 tubes and about 227,000 UY-227 tubes respectively, were sold in the balance of the year 1927.

We were not able to fill orders for UY-227 tubes promptly in 1927. I was unable to keep production up to demand until the latter part of the year, about Novem-

ber first, probably sometime in October, towards the end of October.

I can account for the difference between the number of Radiola 17 sets sold and the number of UY-227 tubes sold, in view of the fact that only one UY-227 tube is used in each Radiola 17. The reason is that there were a large number of other alternating current sets placed on the market during the latter half of 1927, which used the UY-227 tubes.

The experience of the service department with respect to UX-226 and UY-227 tubes in 1927 was that the service department was called upon to make few replacements in the case of UX-226 tubes, but a comparatively large number of replacements had to be made in the case of UY-227 tubes.

The R. C. A. placed on the market new alternating current operated sets in 1928. The Radiola 18, a tuned radio frequency set, was placed on the market in April, 1928; the Radiola 60, in August, 1928, the Radiola 62, in September, 1928, the Radiola 64, in October, 1928. The Radiola 60, 62 and 64 are superheterodyne sets, alternating current operated superheterodyne sets.

I produce copies of the service notes for Radiolas 18 and 60.

MR. BARUS: Defendant offers in evidence service notes for Radiola 18.

(Received in evidence and marked "Defendant's Exhibit No. 12." *See Exhibits, Volume IV, page 695.*)

MR. BARUS: Defendant offers in evidence service notes for Radiola 60.

(Received in evidence and marked "Defendant's Exhibit No. 13." *See Exhibits, Volume IV, page 719.*)

MR. REOCH: The same tubes were used in the Radiola 18 as were used in the Radiola 17. The tubes were used in the Radiola 60 were the UX-280 rectifier tube, seven UY-227 tubes and one UX-171A power output tube. The filaments of these tubes in Radiola 60 were lighted by alternating current.

Radiola 62 was like the Radiola 60 except that Radiola 60 was a table model, while Radiola 62 was housed in a console cabinet together with an electro-dynamic type of loud speaker. Radiola 64 was also similar to Radiola 60 but used a higher power rectifier and output tubes. Radiola 64 was also housed in a console cabinet together with an electro-dynamic type of loud speaker, and the 64 was also equipped with an automatic volume control arrangement.

The Radiolas 18, 60, 62 and 64 did not have adjustable potentiometers bridged across the filament supply system. Fixed type resistors were used in place of adjustable potentiometers.

In the case of the Radiola 18, the schematic diagram in the service notes indicates that variable resistances are used. The wiring diagram, Fig. 11, page 18, in the same notes, shows that the center tap resistor units are fixed. The latter is correct.

In the case of Radiola 60, the schematic diagram in the service notes shows that the adjustable resistances are used. The wiring diagram, Fig. 18, page 24, of the same notes, shows that the center tap resistors are fixed. The latter is correct.

CROSS-EXAMINATION BY MR. EDWARDS:

MR. REOCH: I did not look up the figures to see how many battery operated radio receivers of all types had been sold by the Radio Corporation prior to January 1, 1926, the time when I entered my present position.

I will endeavor to ascertain and report here at the next session the number of each of the types of battery operated sets sold by the Radio Corporation during the years 1925, 1926 and 1927 including the types 25 and 28, which I believe I testified were at times sold as battery operated sets.

The Radiola 16 was put on the market first in July, 1927, and during 1927 about forty or fifty thousand were sold. About 100,000 of the Radiola 17 were sold during 1927.

Without stating in a definite way, I can give an approximate date when Radiolas 25 and 28 were put out as battery operated sets, viz., in August or September, there-

abouts, 1925. That is prior to my connection with the department, but I can produce that information from other information I have received after January 1, 1926.

When those sets were put out they did not contain tubes, all of which were alike, that is, of the same type of tubes.

When battery operated, the tubes of the receiving set were not all UV-199 tubes for UX-199 tubes. There was a UX-120 tube.

When the Radiola 25 was first put out, I can not say definitely that it was not sold without any UX-120 tube, but I think not.

Before the Radiola 25 was put out the company put out the superheterodyne type of receiver. That receiver contained all UV-199 tubes, I believe.

When the company brought out the UX-120 tube, the power tube, it furnished an adapter to go with those sets in order to enable the 120 tube to be used with the UV-199 tube.

That adapter connected up some additional batteries so as to enable the user to add some more batteries to give him a higher plate voltage and a C battery, and so forth.

Then when later the Radiola 25 and 28 came out, they embodied the power tube as a part of the equipment with the necessary voltages. I believe that was so from the outset with the 25 and 28. The 25 used five UX-199 and one UX-120. The superheterodyne set which immediately preceded the 28 and 25 was the one which had the tubes all alike.

In connection with the super-heterodyne set they sold the UX-120 tube and an adapter to enable the user to annex the batteries, and so forth.

When the 25 and 28 came out it embodied the UX-120 tube in the same receiving set or case along with the UV-199 or UX-199 as the case may be.

I was with the Radio Corporation during 1921.

I do not recall that about that time the Radio Corporation offered for sale parts for a one-tube receiving

set operated by alternating current. They may have done so without my having any knowledge of it.

This copy of an advertisement does not refresh my recollection. I cannot say that I have ever seen this advertisement before.

I will make inquiry between now and the next session and endeavor to bring here the instruction book and catalogue referred to in this advertisement which I have just been shown and which is a copy or purports to be a copy of an advertisement appearing on page 600 of *Science and Invention* for November, 1921.

I will also endeavor to ascertain how many of those sets were sold by the Radio Corporation and the period during which they were sold, that is, if the sale extended over more than one year, how many were sold during each year, but if this information is required by next Monday, I am afraid it will be impossible to do that.

JOHN H. DELLINGER.

JOHN DELLINGER, called as a witness on behalf of the defendant, having been duly sworn, testified as follows:

DIRECT EXAMINATION BY MR. BARUS:

MR. DELLINGER: My residence is Washington, D. C. I am chief of the Radio Laboratory of the United States Bureau of Standards.

I have been connected with the radio section of the Bureau of Standards since its formation. It was organized as a definite section in about 1917, and after some changes of organization, it was finally consolidated as a single section of which I was the chief, on February 1, 1921, and I have been the chief since that time.

My duties as chief of the radio section were to supervise and direct the work of the section.

I assign the work to be done by the various men. I supervise the incoming and outgoing correspondence and direct the preparation and submission for official issuance of publications.

The following have been the directors of the Bureau of Standards during my connection with it.

Dr. S. W. Stratton was the director from the bureau's beginning in 1901 to about December, 1922, when he resigned to become president of the Massachusetts Institute of Technology. After a short interregnum, when there was an acting director, he was succeeded by Dr. G. K. Burgess, who has been director until now.

I know Francis W. Dunmore and Percival D. Lowell. They have been members of the radio section.

Mr. Lowell was a member from sometime prior to 1916, I am not sure of the year, until sometime in July, 1922. Mr. Dunmore was a member from about 1917 up to the present.

There were no written contracts concerning the employment of either Francis W. Dunmore or Percival D. Lowell.

There are no written contracts for any members of the bureau. They are appointed through the civil service routine and are simply given a notice of appointment, but no contract as to conditions of employment.

Referring to the article shown me in the *Journal of the American Institute of Electrical Engineers,* at page 310, by Francis W. Dunmore, I am familiar with the device and work described in that article.

It was done during 1921, under my direction.

There is a written record of the work which Mr. Dunmore did in connection with the development of the device described in this article.

A laboratory note book was kept by Mr. Dunmore. He also prepared practically daily brief reports which were submitted weekly, and also monthly reports.

There are rules of the bureau or the section with respect to monthly reports, weekly reports, and laboratory note books such as I have referred to.

Such rules were in writing. I have a copy of such rules. (Producing paper.)

Referring first to the document which I have produced in blueprint form entitled "Notes on Procedure in Radio Laboratory," I will explain briefly what this document is.

This document is a set of notes of the nature of instructions which were prepared by me and given to each of the group chiefs, that is, the chiefs of the major subdivisions of the radio section, giving information as to proper procedure on such questions as organization; the program of work; the preparation of reports, and preparation of publications and correspondence and related matters.

Referring to the document which I have produced entitled "Information for Members of the Radio Laboratory," I have marked it "Only Partial Copy." I do not have a complete copy of these regulations with me.

That is a partial copy of a set of instructions which I gave each member of the laboratory as he joined the bureau. It is dated 1920, and I have copied for present purposes for the purpose of refreshing my memory or any other use here, such portions as seemed to me might be pertinent, because there is only one copy extant of that date, namely, the official copy of the Bureau of Standards.

I will furnish a complete copy certified by the Secretary of Commerce, of the whole of this report, as on file in the Bureau of Standards, if requested to do so.

MR. BARUS: I ask that the documents referred to by the witness be marked Defendant's Exhibits for Identification B and C.

(Received and marked "Defendant's Exhibits B and C for Identification.")

MR. DELLINGER: I am shown a document certified by the Secretary of Commerce as a true copy of the original records specified in the attached list on file in the Bureau of Standards. These certified copies include the monthly, weekly reports of Dunmore and the laboratory notebook of Dunmore to which I referred.

MR. BARUS: The defendant offers in evidence as its Defendant's Exhibit 1 the weekly reports, monthly reports and laboratory notebooks of Dunmore, and I would ask permission to use a photostat copy in place of the certified copies.

MR. BOYCE: May I ask during what period of time and for what purpose these are offered?

MR. BARUS: This exhibit includes the monthly reports of F. W. Dunmore from July, 1921, to July 15, 1922. It includes the weekly report cards of F. W. Dunmore from August 1, 1921 to August 5, 1922, except cards for October 10th to 15, 1921. I may say that I do not know where that is. It was asked for. All were asked for but that one is evidently lost. The laboratory notebook of Dunmore, pages 36 to 73 inclusive covers substantially the same date.

MR. BOYCE: And for what purpose?

MR. BARUS: These notebooks and reports are offered in evidence for several purposes. In the first place as admissions by the plaintiff concerning the invention which they allege they have made. That is applicable not only to this defense but to the merits. In the second place, as showing the time and manner in which the work described in those reports was done and as being admissions of the plaintiffs for that purpose.

THE COURT: That it was done in the Government's time?

MR. BARUS: Yes, that it was done in the Government's time and in the course of their employment and it is also an admission by the plaintiff to show what was done and whether or not it is the same thing as described in the patent in suit.

MR. BOYCE: I want to make the record clear that I object to these weekly reports, monthly reports and notebooks in so far as they tend to prove any rights of the Government on the ground previously stated, namely, that whatever rights the United States Government may have in this invention must be asserted by the Government itself.

THE COURT: Denied, reserving the right to pass on your objection on final hearing.

(Received in evidence and marked "Defendant's Exhibit No. 1." *See Exhibits, Volume IV, page 459.*)

DIRECT EXAMINATION BY MR. BARUS (Continued):

MR. DELLINGER: I will state what I know of the circumstances which led up to the doing of the work relating to the relay described in the article in the *Journal of the American Institute of Electrical Engineering* for April, 1922, at page 310.

That is the article on the relay recorder.

About the beginning of 1921 the War Department asked the Bureau of Standards to carry on for it a number of research projects. One of these was the development of the relay recorder. This particular project was assigned a project number among the others and the character of the work was agreed on between the representatives of the War Department and the bureau. Mr. Dunmore was assigned to this work and was engaged actively upon it particularly during the latter part of 1921.

The result of this work was the development of a successful device in two ... one of them a device actuated by batteries, and the other a device actuated by alternating current. The alternating current feature of the work as I recall begun shortly after I returned from a four months' trip in Europe, my return being about the end of September, 1921, the work being carried on actively from about that time until the end of the year.

Upon the completion of the laboratory phases of the work there were several of the instruments made, the bureau draftsmen participating in the design detail and the bureau shops constructing the apparatus and a publication was prepared and appeared as you have indicated in the *Journal of the A. I. E. E.*

I am shown a paper certified by the Secretary of Commerce as being on file in the Bureau of Standards and entitled "Editorial Record sheet for paper entitled 'A Relay Recorder for Remote Control by Radio by F. W. Dunmore.'" I can identify the signatures on that paper.

I recognize the signature of Mr. Dunmore as author and of Dr. Stratton, as director, approving the publication.

MR. BARUS: It is requested that the paper shown the witness be marked Defendant's Exhibit D for Identification.

(The same paper was marked "Defendant's Exhibit D for Identification.")

By MR. BARUS:

Q. 24. Referring to Defendant's Exhibit D for identification, please explain the rules or regulations of the bureau relating to this document?

MR. BOYCE: I object.

THE COURT: Is it a practice or custom or what?

THE WITNESS: There are no written rules bearing particularly upon this question you now ask. It is a definite practice.

* * * * *
* * * * *

MR. DELLINGER: The particular document you have given me is a form called *Editorial Record,* which was submitted with every paper submitted for publication in the bureau. It includes a short abstract for the convenience of the bureau's editorial committee in considering the paper and for record purposes, the practice of the bureau being that no paper may be issued until after it has been approved first by the chief of the division in which the work is done and then by the editorial committee which reads it and finally the approval of publication by the director.

I believe that is as far as I can go in answering the question inasmuch as the Judge limited me to those things which are not in writing.

THE COURT: Will you now point out such rules as are in writing as pertain to this point?

MR. DELLINGER: All members of my section were given a document prepared by me of which I have a copy before me, dated February 26, 1920, entitled "Preparation of papers," giving information in regard particularly to the form of papers and a small amount of information on procedure in handling them, intended for the

general improvement of the papers put out by the section. That includes a specific statement that when papers are prepared in a periodical rather than in one of the bureau's own series of publications, that it must be submitted for approval by the editorial committee just the same as any other papers for inside publication.

I have also a copy of a document stating the types of abstracts which are required for our bureau for publication. This is one put out by the general office of the bureau and is dated May 31, 1922. The procedure described in it——

MR. BOYCE: I object to that. If we have the document, the document speaks for itself.

* * * * *

THE COURT: He is not defining the procedure or describing it. You may go on.

MR. DELLINGER: The date is May 31, 1922, and it is the earliest version of the rules and abstracts which I was able to find in a brief search before I came here but the practices indicated here were also in effect before May, 1922. If there is an earlier version of this rule in writing in the Bureau of Standards, I will have prepared for submission here a certified copy of such rules covering the period from December, 1921 to May 31, 1922 and also a certified copy of the document which I have produced and which is dated May 31, 1922.

THE COURT: You do not want that certified, do you?

MR. BOYCE: I do not want it certified.

THE COURT: It has been testified that it was the document.

THE WITNESS: The later document I have here and can submit it now. You want a certified copy of the other and I will secure it for you.

MR. BARUS: The defendant offers in evidence the rules for abstracts referred to by the witness dated May 31, 1922.

MR. BOYCE: I desire to cross-examine on the paper.

THE WITNESS: May I ask a question as I am puzzled. You ask me to produce a certified copy. Does that still stand?

THE COURT: Not of this, but of the rules existing prior to May 31st, if you find that they were in writing.

DIRECT EXAMINATION BY MR. BARUS (Continued).

DR. DELLINGER: I am shown an article in the *Journal of the American Institute of Electrical Engineers* for July, 1922, page 488, which I understand is Plaintiffs' Exhibit 7. I am familiar with the device and work described in that article.

I first became acquainted with the work to which that article refers about the early part of January, 1922.

The matter first came to my attention in the following manner: During sometime about December, 1921, there was discussion among various members of the section as to the desirability of undertaking such work. As a part of this discussion, Mr. Dunmore informed me he had made a brief trial of a possible method of accomplishing this and I learned about this time during December that Mr. Lowell and Mr. Dunmore were both very anxious to be authorized to work on this subject as a regular assigned principal task.

I instructed both of the men to go on with the work that they were on, inasmuch as in both cases there was work which I considered to have considerable priority and I kept the matter in mind, however, as that was a matter in which I had considerable interest, and the matter was further discussed among members of the section.

Early in January, Mr. Lowell told me particularly that he would like to work further on this subject and I thereupon requested that he outline such ideas as he had and that he also outline his program as to details of the other job, that I had assigned him to do.

The question of Mr. Dunmore's participating in the development also arose and I instructed Mr. Dunmore to keep on with his work, and Mr. Lowell to put half time on this job and half time on the other job. I was well

aware that Mr. Dunmore had made this previous short experiment mentioned.

By MR. BARUS:

Q. 55. Was your instruction to Mr. Dunmore an instruction not to help Mr. Lowell any further in the work?

MR. BOYCE: Before you answer that question, may I inquire whether your instructions were in writing?

THE WITNESS: My instructions to Mr. Lowell were in writing.

MR. BOYCE: I ask that the testimony of the witness with regard to his instructions which were in writing be stricken out.

THE COURT: That he gave him instructions remains in. What the instructions were, should be stricken out.

MR. BARUS: I think there is a little confusion here. He has been talking about preliminary instructions which he gave Mr. Dunmore and Mr. Lowell which were not in writing. The final instructions which he gave Mr. Lowell were in writing.

By THE COURT:

Q. 56. What you have been testifying about so far were the preliminary instructions or is Mr. Barus in error on that?

A. My preliminary instructions that they keep on with the jobs they were on, that was, as I recall it, oral and subsequently in January I gave him written instructions.

Q. 57. Both Lowell and Dunmore?

A. As I recall it, Lowell only.

THE COURT: What were the instructions will come from the writing.

MR. BARUS: Yes. The question asked for instructions to Dunmore and those were oral instructions.

THE COURT: I see.

DIRECT EXAMINATION BY MR. BARUS (Continued):

DR. DELLINGER: As a result of my preliminary oral instructions to Mr. Lowell, it is my present recollection that the first thing which happened along that line was that Mr. Lowell gave me a very brief statement of his ideas about the work; a report which I considered to be too brief to be of value.

The memo. of January 9, 1922, which is included in the certified papers furnished by the Bureau of Standards is the report to which I refer.

When I received this report, I told Mr. Lowell that this report was not sufficiently detailed and that a more complete report would have to be submitted.

In this regard I gave Mr. Lowell some instructions in writing as to giving me a more full report, but I do not remember at the moment whether I did immediately following this memo. or immediately subsequent to this memo.

My attention is called to a memorandum to Mr. Lowell dated January 11, 1922, which is included in the certified copies of the paper in the Bureau of Standards. That is the memorandum to Mr. Lowell to which I refer.

Mr. Lowell furnished me with a further report as a result of my talk with him. That report is in writing.

My attention is called to the other memo., dated January 12, 1922. That is the report to which I refer, such memorandum being one of those included in the certified documents furnished by the Bureau.

MR. BARUS: Defendant offers in evidence the memorandum of January 9, 1922, furnished by Mr. Lowell to the witness, and the memorandum of January 11, 1922, furnished by the witness to Mr. Lowell and the memorandum of January 12, 1922, furnished by Mr. Lowell to the witness.

MR. BOYCE: My only objection is the underlying one that the Government must assert its own equities.

THE COURT: Yes. Admitted.

MR. BOYCE: May I have the general exception?

THE COURT: You may have exception to all the testimony with respect to this line of examining.

(Said papers were thereupon received in evidence and marked "Defendant's Exhibits Nos. 7, 7-A and 7-B." *See Exhibits, Volume IV, pages 589, 590, 562.*)

DIRECT EXAMINATION BY MR. BARUS:

DR. DELLINGER: Mr. Lowell furnished me with a written record of work which he did in connection with development of the device described in the Plaintiffs' Exhibit 7.

Mr. Lowell furnished me usually weekly and monthly reports and kept laboratory notebooks.

I am shown the documents included in the certified copies furnished by the Bureau of Standards. These are the time cards, laboratory reports and notebooks to which I refer.

I find here for certain times within this period pages from Mr. Lowell's notebook, his monthly reports and his weekly reports. I have not checked the completeness of this period, however. By the way, I believe you used the phrase time cards. These are not time cards but weekly report cards.

MR. BARUS: The documents certified include the weekly reports of Lowell from August 1 to September 1, 1921, and January 3 to January 15, 1922, and the monthly reports include those of Mr. Lowell from July, 1921 to July 15, 1922. The laboratory notebooks includes I understand the whole laboratory notebook.

DIRECT EXAMINATION BY MR. BARUS (Continued).

DR. DELLINGER: The certified copies of the weekly report cards of Mr. F. D. Lowell, furnished by the bureau, do not include any weekly reports from September 24, 1921, to January 3, 1922. I do not know whether or not there were any reports covering that period. I do not know but have some reason to believe that there are not on file in the bureau any weekly report cards covering that period.

I have had searches made for them. I have not searched personally, with the result that no trace of them

could be found. I do not know whether Mr. Lowell kept any laboratory notebook prior to January, 1922.

At the moment I must say I do not know whether or not the Bureau of Standards files contain any laboratory notebook of Mr. Lowell for date earlier than January, 1922.

If there is such a book dating between December, 1921 and 1922, I will furnish a certified copy of same. My own knowledge is this, that within the past year searches have been made many times for documents which would bear on this issue, particularly by Mr. Dunmore and myself, and I think if such a notebook existed we certainly would have found it. Searches were made and the result of them was nothing.

MR. BARUS: Defendant offers in evidence the weekly reports, monthly reports and notebook of Percival D. Lowell, covering the period August 1 to September 24, 1921, and January 3, to July 15, 1922, in the case of the weekly reports; covering the period July, 1921, to July 15, 1922, in the case of the monthly reports; and the whole notebook, I am not sure that the dates are correct.

MR. BOYCE: The same objection.

THE COURT: Same ruling.

(Received in evidence and marked "Defendant's Exhibit No. 8." *See Exhibits, Volume IV, page 596.*)

MR. BARUS: These are offered both on the merits and in connection with the special defense.

DIRECT EXAMINATION BY MR. BARUS (Continued):

DR. DELLINGER: I am shown a document certified by the Secretary of Commerce as being on file in the Bureau of Standards entitled "Editorial Record Sheet" for paper entitled "Notes on the Development of an Electron Tube Amplifier using 60-cycle alternating current to supply power for the filaments and plates" by P. D. Lowell. I can identify the signatures on that document.

They are the signatures of E. C. Crittenden, chief of the electrical division, P. D. Lowell, the author, F. C.

Brown, who was the acting director or assistant director. There are some initials in addition which I can identify.

I can identify the initials. There are my own initials, placed there as second chief under the signature of the chief of the electrical division, and also the initials of H. D. Hubbard initialing for the editorial committee of the bureau.

STATEMENT OF COUNSEL AS TO LICENSES.

"In connection with the testimony of Mr. Brady, plaintiffs' counsel has handed to defendant's counsel copies of thirteen licenses. In order to avoid encumbering the record by copies of these licenses, it is agreed that:

"1. Two of the licenses are under Patent No. 1,455,141, only one of these being granted to Argus Radio Corporation on June 8, 1926 ($1000 being paid on execution as advance royalties) and the other being granted to Fansteel Corporation on July 15, 1926, $5000 being paid on execution as advance royalty for first year and $5000 being agreed to be paid for second year, with right to continue license from year to year on paying $5000 for each year.

"2. Two of the licenses are to Philadelphia Storage Battery Co., one being granted on October 15, 1926, under Patent No. 1,455,141, and patents to issue on 26 listed applications $5000 minimum annual payments in advance) and the other being granted October 7, 1927, under Patent No. 1,635,117.

"3. Two of the licenses are to the Elkon Works under the same patents as the license to Philadelphia Storage Battery Co., the licenses being granted October 15, 1926 ($1000 being paid as advance royalties, with right of license to cancel if the annual royalties do not amount to $1000), and October 5, 1927, respectively.

"4. Three of the licenses are to Grigsby-Gruno-Hinds Co., one being dated February 16, 1927, under Patent No. 1,455,141 and two enumerated applications (minimum of $5000 a year), the second dated October 4, 1927, under Patent No. 1,635,117, and the third being dated November 18, 1927, under No.

1,606,212 with a minimum payment on 5000 units per year.

"5. One license is to the Brandes Products Corporation dated October 1, 1927, under Patents Nos. 1,455,141, 1,606,212 and 1,635,117 and twenty-six applications, requiring payment of a minimum of $5000 a year.

"6. One license is to Briggs & Stratton Corp., dated January 1, 1928, under Patents Nos. 1,455,141, 1,635,117 and twenty-six listed applications, $6000 advance royalties being paid on execution.

"7. One license, dated January 19, 1927, is to Willard Storage Battery Co., under Patent No. 1,455,141 and twenty-six applications, $5000 being paid on execution and a minimum of $5000 to be paid annually.

"8. One license, dated July 13, 1922, is to Morkrum Company under Patent No. 1,635,117 and is limited to relays, payment of $25 for each relay."

MR. EDWARDS: I wish to offer in evidence pages 1 to 4, inclusive, of the proceedings of the American Institute of Electrical Engineers for April, 1922.

(Received in evidence and marked "Plaintiffs' Exhibit No. 53." *See Exhibits, Volume III, page* 199.)

EXHIBITS OFFERED IN THE CASE OF DUBILIER CONDENSER CORPORATION AND FRANCIS W. DUNMORE V. RADIO CORPORATION OF AMERICA, AND DUBILIER CONDENSER CORPORATION, PERCIVAL D. LOWELL AND FRANCIS W. DUNMORE V. RADIO CORPORATION OF AMERICA IN THE DISTRICT COURT OF DELAWARE, AND REFERRED TO IN PROFFER OF EVIDENCE UNDER RULE 46 IN VOL. I, PAGES 230-262 OF RECORD.

PLAINTIFFS' EXHIBIT NO. 1.

Lowell & Dunmore U. S. Patent No. 1,455,141, May 15, 1923, in Suit printed on Pages 2-11, of Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 2.

Dunmore & Lowell U. S. Patent No. 1,606,212, November 9, 1926, in suit, printed at Page 373, Vol. II (Book of Exhibits). This Exhibit is the same as plaintiff's Exhibit 90.

PLAINTIFFS' EXHIBIT NO. 3.

Dunmore U. S. Patent No. 1,635,117, July 5, 1927, in Suit. This patent is printed on pages 12-23 of Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 4.

License Agreement, Dubilier Condenser and Radio Corporation and Francis W. Dunmore and Percival D. Lowell, October 20, 1924. This Exhibit is the same as plaintiffs' Exhibit 4, and is printed on Pages 171-182, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 5.

MEMORANDUM OF AGREEMENT made and entered into this 19th day of May, 1927, by and between DUBILIER CONDENSER CORPORATION, a corporation organized under the laws of the State of Delaware, having its principal office and place of business at 4377 Bronx Boulevard, County of Bronx, City and State of New York (hereinafter called "DUBILIER"), and FRANCIS W. DUNMORE, of the City of Washington, District of Columbia, and PERCIVAL D. LOWELL, of Richmond Hill, in the State of New York (hereinafter called the "INVENTORS"),

WITNESSETH:

WHEREAS, heretofore and on the 20th day of October, 1924, the Inventors made and entered into a certain agreement in writing with Dubilier concerning Letters Patent 1,455,141 granted to the Inventors on May 15, 1923, and entitled "RADIO RECEIVING APPARATUS"; and

WHEREAS, the Inventors have obtained a further patent entitled "POWER AMPLIFIERS" under date of November 9, 1926, known as No. 1,606,212, based on an application filed March 21, 1922, as Serial No. 545,493, and which is separate and apart from Letters Patent No. 1,455,141, embraced by the aforementioned agreement; and

WHEREAS, Lowell, one of said Inventors, has filed applications for improvements on the invention covered by said Letters Patent 1,455,141, which applications are serially numbered 2214 and 2215, and bear a filing date of January 13, 1925.

WHEREAS, Dubilier is desirous of acquiring a license to manufacture, use and sell apparatus embodying the inventions of both aforesaid Letters Patent and said pending applications, and such modifications thereof and improvements thereon as the Inventors have heretofore made or may hereafter make, together with the right to control all future licenses that may be granted, as hereinafter more fully set forth;

NOW, THEREFORE, for and in consideration of the premises and the mutual promises and covenants by each of the parties hereto to the other hereinafter made, and the sum of $1,984.03 by Dubilier to the Inventors in hand paid, the receipt whereof is hereby acknowledged, the parties hereto do hereby agree each with the other as follows:

FIRST: Nothing in this agreement hereinafter contained shall be in any wise construed to avoid, affect, modify or in any wise alter any action that may have been taken by either party to the agreement between Dubilier and the Inventors made and entered into on October 20, 1924, as hereinbefore recited.

SECOND: The Inventors covenant that they are the sole and exclusive owners of the aforesaid inventions and each of them and the patents and applications covering the same, and that they have full right to enter into this agreement, except for the following licenses which have already been granted by them, to wit:

(a) A non-exclusive, non-transferable license to the Timmons Radio Products Corporation covering Letters Patent 1,455,141 only;

(b) A non-exclusive, personal, non-transferable license to the United States Government for governmental purposes only, which arises out of the employment of the Inventors by the Government and is implied by such employment.

THIRD: The Inventors hereby further reserve the right to grant the following licenses under the said patents and applications upon payment of the initial sum mentioned below in the nature of advance royalty and with the royalty per device fixed as hereinafter set forth or upon terms not less favorable to the Inventors and to Dubilier than the terms which are hereinafter described and which the Inventors are privileged to arrange with the prospective licenses, to wit:

(a) A non-exclusive, personal, non-transferable license to the Pathe Phonograph & Radio Corporation or its nominees, upon the payment of One Thousand Dollars ($1,000) advance royalty and a specific royalty of Fifty Cents (50¢) per device;

(b) A non-exclusive, personal, non-transferable license limited to the use of the invention only in connection with the clock mechanisms to the International Time Recording Company upon payment of Five Hundred Dollars ($500) advance royalty and a specific royalty of One Dollar ($1.00) per device;

(c) A non-exclusive, personal, non-transferable license to Brandes Products Corporation upon payment of One Thousand dollars ($1,000) advance royalty, and a specific royalty of Fifty Cents (50¢) per device;

(d) A non-exclusive, personal, non-transferable license for use of invention only in connection with wired wireless to Wired Radio, Inc., upon payment of One Thousand Dollars ($1,000) advance royalty and a specific royalty of Fifty Cents (50¢) per device;

(e) A non-exclusive, personal, non-transferable license to Timmons Radio Products Corporation upon payment of One Thousand Dollars ($1,000) advance royalty and a specific royalty of Fifty cents (50¢) per device, under Letters Patent 1,606,212 and applications Nos. 2214 and 2215 for the manufacture of power amplifiers and loud speakers in addition to the license heretofore granted to

said Company under Letters Patent 1,455,141 hereinbefore referred to, but with respect only to the license to be granted under Letters Patent 1,606,212 the same shall not contain the restrictions, limitations or reservations in favor of the Timmons Radio Products Corporation which are included under the license heretofore granted the said Corporation on Letters Patent 1,455,141; and Dubilier hereby authorizes the issuance of this particular license and authorizes the Inventors to issue the same upon the conditions hereinbefore set forth.

The Inventors hereby covenant and agree that before executing and delivering any of the aforementioned license agreements, they will submit the same to Dubilier for approval by it as to the form thereof and the terms thereof, and Dubilier agrees not to arbitrarily withhold such approval. Dubilier further agrees that it will not require the aforesaid licensees to agree to use Dubilier condensers, provided other consideration is given to Dubilier by way of additional royalties to be paid by the prospective licenses which, in Dubilier's judgment and opinion, is equivalent to the profits which it would have enjoyed upon the sale of such condensers to such prospective licensees, but it is understood that in any event where any licensee does not use Dubilier condensers the inventors shall be entitled to fully one-half of the proceeds of such licenses, as hereinafter set forth.

FOURTH: Since entering into the agreement of October 20, 1924, the following licenses have been granted, although none of these licenses includes any rights under Letters Patent 1,606,212:

Licensee	Date	Subject Matter of License
Peerless Radio Corp.	April 25, 1925	Lowell & Dunmore patent 1,455,141
Peerless Radio Corp. Supplementary agreement B battery kits	July 10, 1925	"
Argus Radio Corp.	June 8, 1926	"
Fansteel Products Corp.	July 15, 1926	"

Elkin Works, Inc.	Sept. 15, 1926	Lowell & Dunmore patent 1,455,141 & applications 2214 & 2215 and also Dubilier applications.
Philadelphia Storage Battery Co.	Oct. 15, 1926	"
Willard Storage Battery Co.	Jan. 17, 1927	"
Willard Storage Battery Co. Addenda to agreement	Feb. 8, 1927	"
Grigsby-Grunow-Hinds Co.	Feb. 16, 1927	Lowell & Dunmore patent 1,455,131 & applications 2214 & 2215.

Copies of all the licenses affecting the subject matter of this agreement are herewith attached and form a part hereof, and as provided in paragraph "First" hereof are not to be affected by this agreement.

FIFTH: It is mutually understood and agreed that should any licensee under the said patent No. 1,455,141 be sued, or threatened with suit under Letters Patent held by an adversary, that the Inventors and Dubilier each shall have the independent right to grant a free non-exclusive license to such adversary in consideration of a similar license under said adversary's patent, or upon such other terms as the parties hereto mutually agree upon, it being expressly agreed however, that each party shall keep the other fully informed in the matter and that each shall safeguard the other, the intent and purpose of the covenant being to provide that all licensees shall be maintained immune from damages arising out of any attack for infringement insofar as the inventors and Dubilier may be able to quiet said attack by licensing the adversary. Any sum or sums which shall be paid for effecting such settlement shall be divided one-half with the Inventors and one-half with Dubilier.

SIXTH: Subject to the licenses and rights already granted and reserved by the Inventors as provided in Paragraph "third" hereof, the Inventors hereby give and grant to Dubilier, its successors and assigns the exclusive right to manufacture, use and sell and to grant to others, upon such terms and conditions as in its uncontrolled judgment and discretion it may deem proper, the right to manufacture, use and sell the aforesaid inventions as covered by both the aforesaid Letters Patents and applications for Letters Patent, and any other improvements of the same class invented or hereafter invented by said Inventors, either solely or jointly, throughout the United States, its territories and dependencies, and covenant to grant to Dubilier or its nominee or nominees, the exclusive right to manufacture, use and sell, and to grant to others the right to manufacture, use and sell inventions in each and every foreign country where said inventions may be covered by Letters Patent.

SEVENTH: The Inventors, during the life of this agreement, agree to file and prosecute any reissue of any United States Letters Patent, as the said Inventors and Dubilier may mutually agree are necessary and desirable to adequately protect the said inventions; and the Inventors covenant and agree to keep Dubilier informed respecting all proceedings in the United States Patent Office in connection with any such reissue, interference or any other proceeding that may arise therein and to consult Dubilier before taking any action that may detrimentally affect its interest, and to submit to Dubilier for approval by it and/or its counsel, before filing the same, any and all papers respecting the said proceedings or any of them.

EIGHTH: Dubilier shall bear the expense of filing and prosecuting any further applications for Letters Patent upon the aforesaid inventions, modifications and improvements, as it may elect to file in the United States or in foreign countries and the expense of maintenance of all Letters Patent that may be granted upon such applications, and hereby agrees to give to the inventors timely written notice as to all countries in which it elects to file additional applications for Letters Patent.

NINTH: The Inventors shall execute all papers that may be necessary or desirable to enable Dubilier, or its

nominee or nominees, to file and prosecute applications for Letters Patent in all countries in which Dubilier shall elect to secure patent protection for said invention, modifications and improvements, and to prosecute all suits thereunder.

TENTH: In order to maintain this license Dubilier covenants to pay to the Inventors during the life of this agreement a royalty of Five Thousand dollars ($5,000) no more and no less for any calendar year, payable Two thousand five hundred dollars ($2,500) on the 30th day of July and Two thousand five hundred dollars ($2,500) thereof on the 30th day of January in each year, said payments to be made by check payable to the Inventors and delivered to them care of F. W. Dunmore, 3411 Rodman Street, Washington, D. C., which address shall be sufficient for all notices hereunder. In any year in which Dubilier fails to pay the full sum of Five Thousand dollars ($5,000) as herein provided, this license shall be automatically terminated, unless within sixty (60) days from the date that the Inventors shall give written notice to Dubilier demanding payment of any deficiency in the amount of such royalty for the preceding year, Dubilier shall make payment of such deficiency; and it shall be the duty of the Inventors to give such notice. Receipt is hereby acknowledged of payment in full of all sums due to the Inventors up to and including December 31st, 1926, under the agreement of October 20, 1924, hereinbefore recited.

ELEVENTH: In addition to said royalty payment by Dubilier to the Inventors paid for the continuation of this license, Dubilier covenants to pay to the Inventors one-half of the royalty payments received from the licenses which may be granted by Dubilier under this agreement and similarly the Inventors agree to pay to Dubilier one-half of the royalty which may be received from licenses hereafter granted by the Inventors, including the licenses heretofore and herein reserved (except as modified by the following paragraph), but all licenses already granted shall be performed as written and executed.

It is understood and agreed, however, that Dubilier may waive its share of the royalties paid by any licensee, in consideration of said licensee agreeing to buy for the duration of the particular license electrical condensers from Dubilier in quantities and at prices satisfactory to

Dubilier; and the Inventors, in every such case shall not be entitled to share in the proceeds of the sale by Dubilier of such condensers. With respect to the reserved licenses herein described, Dubilier shall not be entitled to share the royalties payable to the Inventors if the Licensees shall either have agreed to buy electrical condensers from Dubilier or in lieu thereof pay additional royalty to Dubilier as heretofore in paragraph "Third" hereof provided.

TWELFTH: Should this agreement be terminated for any cause whatsoever prior to the expiration of the patents mentioned, herein, Dubilier covenants and agrees to assign to the said Inventors any and all outstanding licenses which may be granted hereunder and Dubilier shall not thereafter share in the amounts of royalties received by the Inventor from such licenses, if any, after the date of said assignment, except that Dubilier shall always be privileged to continue to enjoy the condenser business reserved to it in lieu of royalties as in any of said licenses provided.

THIRTEENTH: The term "device" as used in this agreement is understood to refer to and include the following:

(a) A device for supplying filament current to radio receiving sets, replacing the usual A battery.

(b) A device for supplying plate current to radio receiving sets, replacing the usual B battery.

(c) A combination device for supplying both A and B battery current for radio receiving sets.

(d) Apparatus comprising a loud speaker sound reproducer of the electrodynamic type operating from the lighting circuit.

(e) Apparatus constituting a power speaker for sound reproduction where the field circuit is supplied with rectified current.

(f) Any combination of two or more of these devices under (a) to (e).

FOURTEENTH: Dubilier and the Inventors agree to require all licensees named to keep proper books of account with reference to all apparatus which they may manufac-

ture and sell embodying the aforesaid inventions, and render periodic statements which shall be open to inspection by both Dubilier and the Inventors, or their duly authorized agents, accompanied by payment of royalties shown to be due. Such statements shall be verified when necessary and may be checked at all reasonable times by an accountant designated by Dubilier and/or the Inventors. Dubilier and the Inventors agree to promptly exchange copies of all reports and statements received from licensees and keep each other informed of the progress of developments under the licenses.

FIFTEENTH: In order to formulate a method of procedure for payments under this agreement, the parties agree as follows:

(a) Dubilier or its nominee shall collect royalties due under all licenses granted by Dubilier or approved by Dubilier and signed by the Inventors;

(b) Said royalties so collected shall be divided equally between Dubilier and the Inventors and the proceeds promptly paid;

(c) Dubilier shall pay Ten per cent. (10%) of the amount received to the Trust Fund now on deposit at the Security Savings & Commercial Bank, 9th and G. Streets, N. W., Washington, D. C., account No. 43,142 in the name of PERCIVAL D. LOWELL, FRANCES W. DUNMORE AND JOHN B. BRADY, TRUSTEES. To these the name of the Treasurer of Dubilier shall be added as a fourth trustee.

(d) The Inventors shall pay Ten per cent. (10%) to the aforesaid Trust Fund of all amounts received from all licensees but the Inventors shall not be required to pay any amounts to said Trust Fund arising from licenses granted to Timmons Radio Products Corporation or from the minimum annual sum payable by Dubilier in accordance with paragraph "Tenth" hereof.

SIXTEENTH: The Inventors and Dubilier mutually agree that the amounts paid into said Trust Fund shall be used within the discretion of the Trustees in the Payment of legal expenses incident to suits in which the Inventors may join and for the protection of the patent situation relating to the inventions herein referred to. It is also mutually understood and agreed that when the said Trust

Fund shall total the sum of Five thousand dollars ($5,000) that payments into the same may be discontinued, to be resumed when necessary to re-establish the aforesaid amount. The Trustees shall render an account and statement of said fund semi-annually.

SEVENTEENTH: The Inventors hereby give and grant to Dubilier the right to sue in its own name and at its own expense any infringers of said patent or patents and to collect for its own use and behoof such damages and profits as may be assessed as the result of such suit or suits, provided, however, that in all cases where the Inventors wish to join in any suit or suits they shall have the right so to do, in which event the expenses shall be paid out of said Trust Fund, and when such fund is insufficient, any additional amount required shall be paid in equal shares by the Inventors and Dubilier; and the Inventors shall then share equally in the division of all moneys received, as damages or profits that may be collected.

EIGHTEENTH: The Inventors hereby specifically grant to Dubilier the right to grant sub-licenses to others under the aforesaid patents, and in every instance the Inventors are to be furnished with a copy of any agreement for any inventions within the scope of this agreement. For the general protection and advancement of the patent situation, Dubilier agrees to consider the granting of licenses to others under the patents herein set forth whenever the Inventors deem it beneficial so to do, and in any such case Dubilier agrees to act promptly on the application for such a license or the suggestion of the Inventors with respect thereto.

NINETEENTH: If, as a result of court decisions, substantial protection for the main subject-matter of this agreement is not afforded by said patents or if adversely held patents are declared to prevent manufacture of devices under said patents, Dubilier may terminate this agreement if it shall so elect and restore all rights hereunder to the Inventors including an assignment of all the outstanding licenses.

TWENTIETH: In case of the termination of this agreement, for any cause whatsoever, all rights and obligations of the parties hereunder shall cease and their original

rights of prosecution and defense of infringement suits shall be restored, except as stated in Paragraph numbered Twelve above.

TWENTY-FIRST: If any controversy shall arise between the parties as to the performance of any obligation under this agreement, the matter in controversy shall be submitted at the option of either party, to three arbitrators who shall have power to decide the matter in controversy, and to determine what, if any, amount shall be paid by either party to the other as liquidated damages for any breach of this agreement, and each party agrees to pay to the other any damages that may be assessed by the arbitrators. Upon such contingency either party may elect to arbitrate and shall notify the other party by registered mail. Within thirty days from the date of receipt of such notification both parties must appoint an arbitrator, and within sixty days after the date of such appointment both arbitrators must appoint a third arbitrator. If either party fails to appoint an arbitrator within the specified time, then the other party can apply to the American Arbitration Association to appoint for him the arbitrator, whom he must accept, and if both parties cannot decide upon a third arbitrator within the specified time, then they may apply to the American Arbitration Association for the third arbitrator.

TWENTY-SECOND: This agreement is assignable and the agreement and the covenants herein contained shall be binding upon and inure to the benefit of the heirs, executors, administrators, successors and assigns of the parties hereto.

TWENTY-THIRD: Dubilier agrees under this license not to enter into the manufacture of apparatus under the invention covered by Letters Patent 1,455,141 within an area of ten miles of Philadelphia, and agrees further not to grant licenses to others engaging in such manufacture in said area without the consent of the Inventors, but this limitation and reservation shall not apply to articles manufactured under the invention covered by Letters Patent 1,606,212.

IN WITNESS WHEREOF, Dubilier has caused these presents to be signed by its proper officer and its corporate seal to be hereunto affixed, and the Inventors have here-

unto set their hands and seals the day and year first above written.

DUBILIER CONDENSER CORPORATION

(Seal) By (Sgd.) FRED D. WILLIAMS,
Pres.

Attest:
W. J. SMITH
Secretary

PERCIVAL D. LOWELL

Witness:
R. JORDAN

FRANCIS W. DUNMORE

Witness:
CHAS. G. HUBBARD

STATE OF NEW YORK }
COUNTY OF BRONX } *ss.:*

On this 12th day of May, 1927, personally appeared before me FRED D. WILLIAMS, to me known and known to me to be the President of the DUBILIER CONDENSER CORPORATION of New York City, and he duly acknowledged to me that he executed the foregoing instrument on behalf of the said Corporation, and that he was fully authorized to do so.

WITNESS my hand and Notarial Seal.

ARTHUR WILLIAMS, JR.,

(Seal) Notary Public.
(Stamp)

STATE OF NEW YORK }
COUNTY OF QUEENS } *ss.:*

On this 16th day of May, 1927, personally appeared PERCIVAL D. LOWELL, to me known and known to me to be the individual named in and executed the foregoing instrument, and he duly acknowledged to me that he executed the same of his own free will for the purpose therein set forth.

WITNESS my hand and Notarial Seal.

REYNOLD JORDAN

(Seal) Notary Public.
(Stamp)

CITY OF WASHINGTON }
DISTRICT OF COLUMBIA } *ss.:*

On this 19th day of May, 1927, personally appeared FRANCIS W. DUNMORE, to me known and known to me to be the individual named in and who executed the foreing instrument, and he duly acknowledged to me that he executed the same for the purpose therein set forth.

WITNESS my hand and Notarial Seal.

CHARLES G. HUBBARD

(Seal) Notary Public.
D. C.
(Stamp)

PLAINTIFFS' EXHIBIT NO. 6.

AGREEMENT

THIS AGREEMENT executed this 15th day of July, 1927, by and between DUBILIER CONDENSER CORPORATION, a Corporation of the State of Delaware, having an office and place of business at 4377 Bronx Boulevard, New York City, and FRANCIS W. DUNMORE of Washington, District of Columbia.

WITNESSETH THAT WHEREAS, FRANCIS W. DUNMORE did on February 27, 1922 file application for Letters Patent of the United States on improvements in Relays, Serial

Number 539,591, and has obtained thereon Letters Patent No. 1,635,117, dated July 5, 1927; and

WHEREAS on July 13, 1922 the said Francis W. Dunmore entered into a license agreement, as per the attached copy, with Morkrum Company of Chicago, Illinois, covering the use of his invention in connection with printing telegraph and other electrical apparatus; and

WHEREAS, the invention as covered by said Letters Patent is also susceptible of use in radio broadcast entertainment receivers and particularly in electron tube apparatus as covered by Lowell and Dunmore patents No. 1,455,141, dated May 15, 1923 and No. 1,606,212, dated November 9, 1926, which form the subject matter of an agreement between said Dunmore and his co-inventor said Lowell, and said Dubilier Condenser Corporation dated May 19, 1927.

NOW, THEREFORE, TO ALL WHOM IT MAY CONCERN, BE IT KNOWN that for and in consideration of One Dollar ($1.00) by each party to the other in hand paid and the mutual provisions and covenants hereinafter set forth, the parties hereto have agreed and do agree as follows:

1. The parties to this instrument hereby state and declare that said patent 1,635,117 is embraced by said agreement of May 19, 1927, but only so far as it may cover radio-telephone broadcast receiving apparatus and not with respect to its use as a remote control device or apparatus for operation of relay mechanism, and said patent No. 1,635,117, is now hereby expressly included within said agreement, on the same terms, reservations, provisions and conditions, and no more, stated in said agreement as affecting the aforesaid Patent No. 1,606,212, and said Dunmore hereby retains for his own sole use and benefit, in connection with said patent No. 1,635,117, reservations, limitations and privileges of the same scope, nature, force and effect as those retained by Francis W. Dunmore and Percival D. Lowell jointly under said agreement with respect to Letters Patent 1,606,212. It is further understood and agreed that Francis W. Dunmore reserves to himself the exclusive right to grant licenses, collect royalties and otherwise personally enjoy for himself, his heirs, his legal representatives and his assigns all the benefits of the invention covered by said Letters Patent No. 1,635,117, wherever said invention is

used for the control of a remote control device or apparatus for operation of relay mechanism for effecting the opening and closing of an electrical circuit, but the rights so reserved by said Dunmore shall not in any manner extend to the manufacture, use, or sale of the invention as a rectifier or battery substitute for utilization in radio telephone broadcast receiving apparatus.

2. Dubilier Condenser Corporation agrees that in all licenses which may hereafter be granted under said Letters Patent 1,635,117 for radio telephone broadcast receiving apparatus, either singly or in conjunction with patents 1,455,141 and 1,606,212, the following clause must be included:

> "This license does not extend to licensee any rights under Letters Patent 1,635,117, to make, use or sell the invention of this patent as a circuit maker and breaker, such as for an electrical relay."

IN WITNESS WHEREOF the said DUBILIER CONDENSER CORPORATION has caused this agreement to be signed by its President and its corporate seal to be hereunto affixed, and the said FRANCIS W. DUNMORE has hereunto set his hand and seal the day and year first above written.

DUBILIER CONDENSER CORPORATION

By (Sgd.) FRED D. WILLIAMS.
President.

Attest:

(Sgd) W. J. SMITH
Secretary.

(Sgd) FRANCIS W. DUNMORE

Witness:

(Sgd) JOHN B. BRADY

STATE OF NEW YORK }
COUNTY OF BRONX } *ss.:*

On this 22nd day of July, 1927, personally appeared before me FRED D. WILLIAMS, to me known and known to me to be the President of the DUBILIER CONDENSER CORPORATION of New York City, and he duly acknowledged to me that he executed the foregoing instrument on behalf of the said Corporation, and that he was fully authorized to do so.

WITNESS my hand and Notarial Seal.

(Sgd) ANDREW A. MILLER

(Seal) (Stamp)

CITY OF WASHINGTON }
DISTRICT OF COLUMBIA } *ss.:*

On this 15th day of July, 1927, personally appeared FRANCIS W. DUNMORE, to me known and known to me to be the individual named in and who executed the foregoing instrument, and he duly acknowledged to me that he executed the same for the purpose therein set forth.

WITNESS my hand and Notarial Seal.

(Sgd) ELLEN G. McCARTHY

(Seal) Notary Public.
D. C.

(Stamp)

AGREEMENT.

This agreement, made this 13th day of July, 1922, between FRANCIS W. DUNMORE, of Washington, in the District of Columbia, party of the first part, and MORKRUM COMPANY, of Chicago, Illinois, a corporation of Maine, party of the second part, witnesseth: That, whereas the party of the first part is the inventor of certain improvements in Relays on which application for patent Serial Number 539,591, filed February 27th, 1922, is now pending; and whereas the party of the second part is desirous of manufacturing Relays embodying said improvements; Now, therefore, the parties have agreed as follows:

1. The party of the first part hereby agrees to license and empower the party of the second part to manufacture, or cause to be manufactured, Relays containing said improvements subject to the conditions hereinafter named, to the end of the terms of all Letters Patent which may be granted on said application, and to sell or lease the same. This license shall be exclusive to the party of the second part insofar as said device may be used with printing telegraph apparatus, without restriction (one type of which is the Morkrum Company Teletype Printer) or apparatus which performs a similar function, or which apparatus in a similar manner but which may perform other functions than printing letters. It is understood that the relay when used, as herein provided, may be operated by any suitable signal sent in any manner whatsoever without restriction.

II. In addition to the above exclusive license, the party of the first part hereby grants to the party of the second part a non-exclusive license to manufacture, and/or cause to be manufactured, sell or lease the said device for any purpose not covered in Paragraph 1.

III. The party of the first part agrees to furnish to the party of the second part working drawings of the relays and supply any technical information necessary in assisting with the production of the instruments.

IV. The party of the second part agrees to make full and true returns to the party of the first part, under oath, upon the first days of January, April, July and October in each year, of all relays containing the improvements covered in the above entitled application manufactured by them, or for them and sold or leased by them.

V. The party of the second part agrees to pay to the party of the first part Twenty-five ($25.00) Dollars as a license fee upon every relay manufactured by, or for said party of the second part containing the improvements covered by the above entitled application and sold or leased by them, and further agrees that after granting of the patent thereon, and beginning with the date of issue of said patent, to pay a minimum of $500 in royalties per year and on failure to pay this sum for any year this license shall automatically become entirely a non-exclusive license.

VI. The party of the second part agrees to place on the name plate affixed to this apparatus, in addition to any identification desired by the Company, the following notice:

DUNMORE RELAY

PATENT PENDING

and to mark the same with the patent number and date upon the granting thereof.

VII. Upon a failure of the party of the second part to make returns or to make payment of license fees, as herein provided, for thirty days after the days herein named, the party of the first part may terminate this license by serving a written notice upon the party of the second part; but the party of the second part shall not thereby be discharged from any liability to the party of the first part for any license fees due at the time of the service of said notice.

IN TESTIMONY WHEREOF THE MORKRUM COMPANY has caused this instrument to be executed by its officer thereunto duly authorized, and its corporate seal to be affixed, and FRANCIS W. DUNMORE, has signed and sealed this instrument this 5th day of July, 1922.

FRANCIS W. DUNMORE

MORKRUM COMPANY

By STERLING MORTON

President.

Witness

JOHN B. BRADY

J. O. CARR

CITY OF WASHINGTON
DISTRICT OF COLUMBIA } *ss.*:

On this 5th day of July, 1922, before me, personally appeared FRANCIS W. DUNMORE, to me known and known to me to be the individual named in and who executed the foregoing instrument, and he duly acknowledged to me that he executed the same.

WITNESS my hand and Notarial Seal.

CHRISTIE H. FESSLER

(Seal) Notary Public, D. C.

STATE OF ILLINOIS
COUNTY OF COOK } *ss.*:

On this 13th day of July, 1922, personally appeared before me STERLING MORTON, to me known and known to me to be the President of the Morkrum Company, of Chicago, Illinois, and he duly acknowledged to me that he executed the foregoing instrument on behalf of said company, and that he was fully authorized to do so.

WITNESS my hand and Notarial Seal.

LATHER VICTOR KRAUSE

(Seal) Notary Public.

PLAINTIFFS' EXHIBIT NO. 8

Paper No. 450, October 2, 1922, U. S. Bureau of Standards, "An Electron Tube Amplifier using 60-Cycle Alternating Current to Supply Power for the Filaments and plates," by P. D. Dowell. This exhibit is the same as plaintiffs' exhibit No. 106 and is printed in Vol. II (Book of Exhibits) at page 518.

PLAINTIFFS' EXHIBIT NO. 9

In Reply Refer to

GENERAL ELECTRIC COMPANY
General Office
SCHENECTADY, N. Y.

May 25, 1923.

Mr. John B. Brady,
Ouray Building,
Washington, D. C.

Dear Brady:

I have taken the liberty to bring to the attention of our Engineering Department, a patent No. 1455141, which you sent me on May 16.

I assure you that this matter will be given careful consideration and that you will be notified in the near future as to whether the General Electric will care to negotiate at this time for the rights of this patent.

Thanking you for bringing this matter to my attention, I wish to remain

Yours sincerely,

WENDELL L. CARLSON

Radio Engineering Dept.

WLC:S

John B. Brady
Received
May 28 1923
Washington, D. C.

PLAINTIFFS' EXHIBIT No. 10.

RADIO CORPORATION

66 BROAD STREET

NEW YORK

(Cut: Worldwide Wireless)

Ira J. Adams
Patent Attorney

Telephone
Broad 7100

Harry G. Grover
James G. Norton
Clyde A. Norton
Assistant Attorneys

November 16, 1923.

Mr. John Brady,
Ouray Building,
Washington D, C.

Dear Sir:

You asked us to consider the purchase of the Lowell and Dunmore patent 1,455,141. You also discussed the matter with me in my office here several weeks ago. I told you in general about our views and you asked me to think the matter over further and then definitely write you about the matter.

I carefully considered the question and we have decided that there are no valid claims in this patent that would be of interest to us.

Very truly yours,

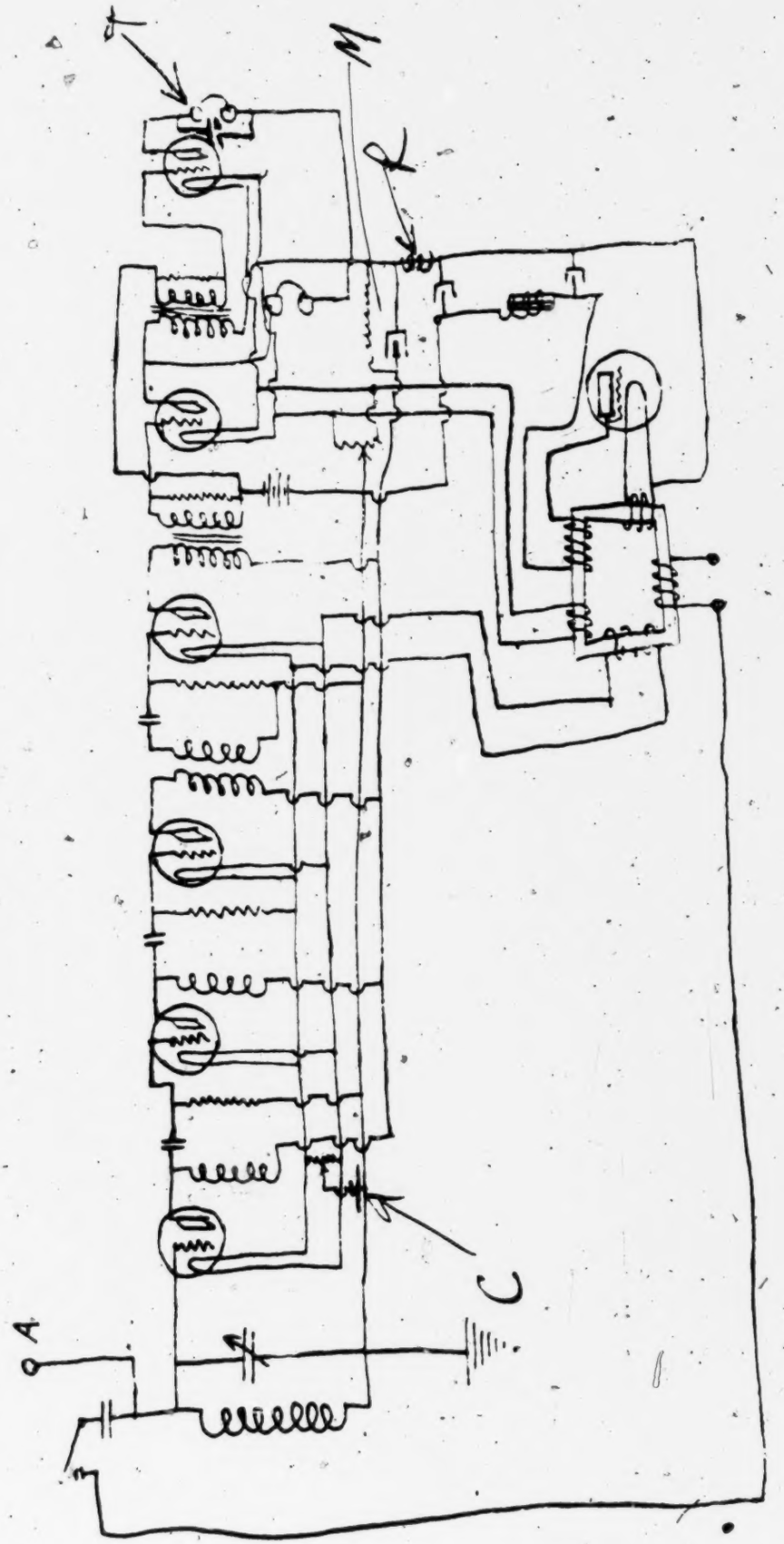
IRA J. ADAMS

ija-g
cc/HED

John B. Brady
Received
Nov. 17 1923
Washington, D. C.

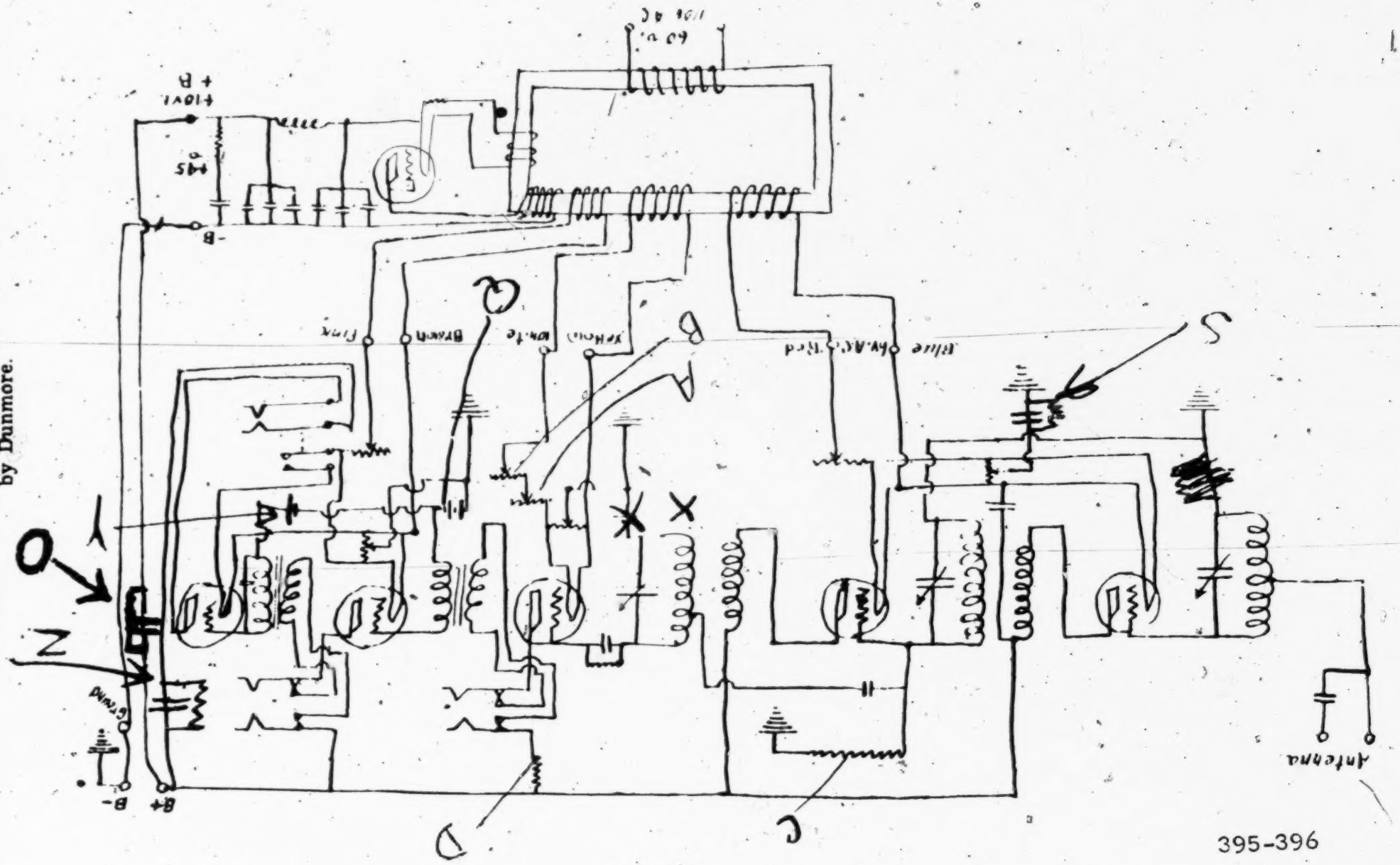
PLAINTIFFS EXHIBIT NO. 11.

Brady Diagram of Circuit of Dunmore Radio Set



393-394

PLAINTIFFS' EXHIBIT NO. 12.
Brady Diagram of Circuit of Freed Radio Set Used by Dunmore.



395-396

PLAINTIFFS' EXHIBIT NO. 13.

RADIO CORPORATION
OF AMERICA
233 BROADWAY

Ira J. Adams
Patent Attorney
Harry G. Grover

Harry G. Grover
James G. Norton
Carl M. Cohen
Samuel B. Smith
Terry B. Morehouse
David J. Bonett
Bernard S. Franklin
Harry Tunich
Phil L. Rodier
Samuel Tierney
Frank S. Misterly
Joseph D. Black
John M. Monstream

July 19, 1927.

John B. Brady, Esq.,
Ouray Building,
Washington, D. C.

Dear Mr. Brady:

I have your letter of July 13th in respect to the alleged infringement of patents 1,455,141, 1,606,212, 1,635,117.

We have already examined patents 1,455,141 and 1,606,212 and it is our position that we do not infringe any valid claims of these patents. Patent 1,635,117 has only recently come to our attention and we have not completed our study of the patent.

In respect to the charge that we are aiding and abetting others in the infringement of the patents referred to, as you no doubt know, we are doing nothing but licensing concerns under our patents and this we have the right to do.

Very truly yours,
IRA J. ADAMS

ija:kms

John B. Brady
Received
Jul. 21, 1927
Washington, D. C.

PLAINTIFFS' EXHIBIT NO. 13-A.

(Copy)

July 13, 1927.

Radio Corporation of America,
Woolworth Building,
New York City, N. Y.

Registered Mail.

Gentlemen:

My clients; Messrs. Lowell and Dunmore, and Dubilier Condenser Corporation, direct me to call your attention to Letters Patent of the United States numbered as follows:

1,455,141	May 15, 1923;
1,606,212	Nov. 9, 1926;
1,635,117	July 5, 1927;

which they are informed you are infringing.

You are also aiding and abetting others in the infringement of the above patents through the operations of your Socket Power Licenses, and my clients feel that you should respect their rights in the same way you expect others to recognize your patent rights.

You are requested to make settlement for past infringement and to notify me that you will desist from further infringement of these patents.

Yours very truly,

JBB/md

PLAINTIFFS' EXHIBIT NO. 13-B.

RADIO CORPORATION
OF AMERICA
233 Broadway
NEW YORK

Ira J. Adams
Patent Attorney

Harry G. Grover
James G. Norton
Edward W. Fearing
Carl M. Cohen
Samuel B. Smith
Terry B. Morehouse
David J. Bonett
Bernard S. Franklin
Harry Tunick
Phil L. Rodier
Samuel Tierney
Frank S. Misterly
Joseph D. Black
John M. Monstream

John B. Brady
Received
Jul 12 1927
Washington, D. C.

July 11, 1927.

Mr. John B. Brady,
Counsellor at Law,
Ouray Bldg.,
Washington, D. C.

Dear Mr. Brady:

Mr. Beam has sent me a copy of your letter to him of July 1st in respect to the Lowell and Dunmore patents.

We have gone quite thoroughly into the Lowell and Dunmore patents and talked to you about them several years ago. In view of our study of such patents, I think it would be a waste of time to have an interview on the situation. However, I do not want to close the door to anyone who thinks he has something of importance to say, and if you want to talk to me I will be glad to confer with you on a date that is mutually satisfactory. I do not think at this stage that there should be a joint conference.

Very truly yours,

cc-Mr. Beam
ija :kms

IRA J. ADAMS.

PLAINTIFFS' EXHIBIT NO. 13-C.

WESTINGHOUSE ELECTRIC &
MANUFACTURING COMPANY

150 Broadway, New York

July 5, 1927.

Office of
Victor S. Beam,
Assistant to
Vice President Terry

John B. Brady, Esq.,
Ouroy Building,
Washington, D. C.

Dear Sir:

Referring to yours of the 1st instant, I think the question you raise is one which should be taken up initially with the Radio Corporation and I am sending a copy of your letter to Mr. Ira J. Adams, patent attorney of that Corporation, asking him to look into this matter.

Yours truly,

VICTOR S. BEAM
Assistant to
Vice President.

Received
John B. Brady
Jun 6 1927
Washington D. C.

PLAINTIFFS' EXHIBIT NO. 13-D.

July 1, 1927.

Mr. Victor S. Beam,
Westinghouse Electric & Mfg. Co.,
150 Broadway,
New York City.

Dear Mr. Beam:

With reference to your letter of June 24, 1927, stating that Radio Corporation of America and its associated licensors do not guarantee to socket power licensees immunity from suits under patents not owned or controlled by the licensors, my clients, Messrs. P. D. Lowell and F. W. Dunmore would appreciate an appointment with you and representatives of the licensors. At this meeting my clients would like to discuss the scope of the claims of Letters Patents Nos. 1,455,141, 1,606,212 and 1,635,117.

If convenient to you, we would like to meet in New York, and we suggest July 7, 1927, at 10 A. M. in your office, unless some other time would be more agreeable.

Yours very truly,

JBB/ls

(In lead pencil): Dunmore Note & return

J. B. B.

PLAINTIFFS' EXHIBIT NO. 13-E.

WESTINGHOUSE ELECTRIC &
MANUFACTURING COMPANY

150 Broadway, New York

Office of
Victor S. Beam,
Assistant to
Vice President Terry

June 24, 1927.

John B. Brady, Esq.,
Ouray Building,
Washington, D. C.

Dear Sir:

Replying to yours of the 13th instant, the Radio Corporation of America and its associated licensors do not guarantee the socket power licensees immunity from suits under patents not owned or controlled by those Companies.

Yours truly,

VICTOR S. BEAM

Assistant to
Vice President.

John B. Brady
Received
Jun 26 1927
Washington, D. C.

PLAINTIFFS' EXHIBIT No. 13-F.

June 13, 1927.

Mr. Victor Beam,
150 Broadway,
New York City, N. Y.

Dear Mr. Beam:

I have clients who control patents and pending applications about to issue on the subject of socket power devices.

A selected number of the larger manufacturers have been extended licenses by my clients and substantial numbers of B eliminators and socket power devices have been manufactured and sold under the licenses thus granted. There are a number of applicants for prospective licenses at the present time under consideration by my clients and attention has been called to the fact that apparently a conflicting patent situation exists as licenses for the manufacture of socket power devices are also being offered by Radio Corporation of America.

I would like to inquire whether it is the policy to protect and save harmless the licensees under the socket power licenses extended by Radio Corporation of America from attacks by other patentees. My clients would greatly appreciate having your view as to the extent of liability assumed by a licensee of Radio Corporation of America on socket power devices. If Radio Corporation of America, in granting a socket power license, guarantees its licensees immunity from suits under other outstanding patents in the art, then the policies of my clients can be formulated with much greater precision.

I would certainly appreciate it if you will favor me with a copy of the form of socket power license offered by Radio Corporation of America.

Yours very truly,

JBB/hir

PLAINTIFFS' EXHIBIT NO. 46.

Photograph of Lowell & Dunmore Box Type Radio Set. This Exhibit is the same the plaintiffs' Exhibit 47 and is printed on page 253, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 47.

Photograph of Lowell & Dunmore Neutrodyne Set. This Exhibit is the same as plaintiffs' Exhibit 49 and is printed on Page 255, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHHIBIT NO. 48.

Lowell & Dunmore Box Type Set. This Exhibit is the same as plaintiffs' Exhibit 26. By stipulation of Counsel Vol. I, Page 281, this Exhibit is treated as a Physical Exhibit.

PLAINTIFFS' EXHIBIT NO. 49.

Lowell & Dunmore Neutrodyne Set. This exhibit is the same as plaintiffs' Exhibit 27. By stipulation of Counsel Vol. I, page 281, this exhibit is treated as a Physical Exhibit.

PLAINTIFFS' EXHIBIT NO. 49a.

Rectifying Unit for Lowell & Dunmore Neutrodyne Set. This Exhibit is the same as plaintiffs' Exhibit 28. By stipulation of Counsel Vol. I, page 281, this exhibit is treated as a Physical Exhibit.

PLAINTIFFS' EXHIBIT NO. 50.

Original Diagram of Lowell-Dunmore Box Type Set. This Exhibit is the same as plaintiffs' Exhibit 50, Volume II, page 258 (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 51.

(Copy)

AGREEMENT

This agreement made this 1st day of June, 1922, between F. W. Dunmore and P. D. Lowell, both of Washington, D. C., parties of the first part, and the Radio Instrument Company, incorporated under the laws of the State of Delaware, party of the second part, WITNESSETH:

That whereas the parties of the first part have made application in the United States Patent Office for letters patent, application Serial No. 541,111, filed March 27, 1922, for improvement in radio receiving apparatus, and whereas the party of the second part is desirous of manufacturing radio apparatus containing the said improvements and of securing the services of the parties of the first part, now therefore, the parties have agreed as follows:

I. The parties of the first part hereby license and empower the party of the second part to manufacture, subject to the conditions hereinafter named, at Washington, D. C., or in other places, to the end of the term for which said letters patent may be granted, apparatus containing the said improvements and to sell the same. The parties of the first part further agree that they will make application for letters patent on the invention identified by the application S. N. 541,111 in foreign countries at the request of the party of the second part and that rights secured shall be subject to the same royalty agreement as hereinafter provided. It is understood, however, that all expenses incident to obtaining patents in foreign countries shall be paid by the party of the second part.

II. Mr. P. D. Lowell, one of the parties of the first part, agrees to enter the employ of the party of the second part at a salary of $75 per week, his employment to begin on or before the 1st day of July, 1922, and he further agrees that he will continue in said employment

for a period of six months from date, and will devote himself exclusively to the development of the improvements covered by the said application S. N. 541,111.

III. It is understood that this contract is not to become binding on any of the parties hereto unless the sum of One Thousand Dollars ($1,000.00) shall have been paid to the parties of the first part by the party of the second part, said One Thousand Dollars ($1,000.00) to be an advance payment on any royalties which may accrue during the first six months as provided in Section II.

IV. The party of the second part agrees to pay to the parties of the first part until such time as letters patent shall be issued upon application S. N. 541,111, a royalty of one per cent (1%) of the gross sales price for each instrument manufactured and sold by the party of the second part, provided that such royalty is not to be less than Two Dollars ($2.00) per instrument. From the date of the issuance of the letters patent upon the said application S. N. 541,111, the royalty fee due from the second party to the first parties for each instrument manufactured and sold by the second party shall be increased to five per cent (5%) of the gross selling price of the instrument; Provided, however, that such royalty shall not exceed $7.50 per instrument. All royalties due to the parties of the first part shall be paid on or before the 10th day of each month.

V. It is further agreed that if, within six (6) months from the date of this agreement the party of the second part shall so request, the parties of the first part shall transfer and make over to the party of the second part the exclusive domestic and foreign rights upon the same terms as to royalties to manufacture and sell the instrument which is the basis of application S. N. 541,111, provided that the second party six (6) months after the date of this agreement shall pay to the said first parties either Ten Thousand Dollars ($10,000.00) at the rate of Two Thousand Dollars ($2,000.00) cash and Two Thousand Dollars ($2,000.00) every thirty days for four months, or two hundred (200) shares of the preferred capital stock and one hundred (100) shares of the common capital stock of the second party, as the first parties shall elect. In case, however, the party of the second part does not

elect to exercise its option to purchase the exclusive right by payment of the Ten Thousand Dollars ($10,000.00) cash or stock as provided in the foregoing paragraph, the parties of the first part agree that the party of the second part may continue to manufacture on a non-exclusive basis the instrument which is the basis of application S. N. 541,111 upon the same terms and conditions as to royalties as herein provided. When the patent issues on application S. N. 541,111, the Radio Instrument Company agrees that each instrument sold shall be conspicuously marked by a plate or otherwise substantially marked as follows:—"Licensed under Lowell-Dunmore U. S. Patent No. ..... date."

VI. It is agreed by the party of the second part that in order to maintain their exclusive or non-exclusive license, they will manufacture annually a minimum of one thousand (1,000) instruments to net to the parties of the first part a minimum of Two Thousand Dollars ($2,000.00) in annual royalties, or in case they are unable to manufacture that number of instruments they agree to pay a minimum amount of Two Thousand Dollars ($2,000.00) to the parties of the first part each year, and upon failure to do so it is understood that the license shall automatically revert to the parties of the first part.

VII. It is agreed by the party of the second part that in case it takes over the exclusive patent rights as provided in Section V they will pay all expenses of litigation that may arise in connection with establishing the validity of the patent.

VIII. The party of the second part shall make full and true returns to the parties of the first part under oath upon the 10th day of each month of all apparatus containing the improvements for which letters of patent have been applied. Should the parties of the first part so desire, they may at any time in regular business hours examine the books and records of the second *part* to check the manufacture and sales made of the instruments covered by this license.

IX. Upon a failure of the party of the second part to make returns or to make payment of license fees, as herein provided, for sixty (60) days after the 10th day of each month, the parties of the first part may terminate this license by serving a written notice upon the

party of the second part, but the party of the second part shall not thereby be discharged from any liabilities to the parties of the first part for any license fees due at the time of the serving of the notice.

X. It is understood that unless the One Thousand Dollars ($1,000.00) advance payment on royalties as provided in Section III is not paid by the party of the second part to the parties of the first part on or before Saturday, June 10th, 1922, the parties of the first part shall consider this contract void and of no effect, unless extension is granted upon the same terms.

IN WITNESS WHEREOF the parties here above named have hereunto set their hands and seals the day and year first above written at Washington, D. C.

Radio Instrument Co.

By Brent Daniel.

Percival D. Lowell

Francis W. Dunmore

(SEAL)

XI. The parties of the first part hereby agree to extend the time limit mentioned in paragraph X from June 10, 1922 to June 24, 1922.

Radio Instrument Co.

By Brent Daniel.

Percival D. Lowell

Francis W. Dunmore.

PLAINTIFFS' EXHIBIT NO. 52.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

East Pittsburgh, Pa.

Office of
O. S. Schairer,
Director of
Patent Development

Mr. John B. Brady,
Ouray Building,
Washington, D. C.

July 31st, 1923.

Dear Mr. Brady:—

I have your letter of July 23rd, directing our attention to Lowell et al. patent No. 1,455,141.

As you know, we have already looked into this patent and have sent you a copy of the file wrapper. Our purpose in doing this was to determine whether or not we could properly make certain of the claims of the Lowell patent in a pending application of ours that has been in the Office for several years. It is our opinion that this pending application discloses every material part of the invention claimed in the Lowell patent. For this reason, it is not likely that we shall be interested in the patent in question unless it should appear that Lowell and Dunmore are able to establish a date of invention several years prior to the filing date of their patent.

Thanking you for having given us an opportunity to consider this matter, I am,

Very truly yours,

C. T. ALLCUTT,
Bureau of Patent Development.

CTA/JMc

John B. Brady
Received
Aug 2 1923
Washington, D. C.

PLAINTIFFS' EXHIBIT NO. 52-A.

July 23, 1923.

Bureau of Patent Development,
Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

Gentlemen:

When your company first actively started to construct a radio patent situation, I was called upon to extend you assistance which may special collection of radio patents afforded at that time. Since then Messrs. Dunmore and Lowell, clients of mine, have called upon me to construct a patent situation upon their invention in a radio receiver which uses the alternating current house lighting circuit to energize the filament and plate circuits of the electron tube receiving amplifier. Patent 1,455,141 was granted to them showing one circuit arrangement for a receiver of this kind. I have been called upon to arrange licenses in response to a number of applicants for the manufacture of receivers using the house lighting circuit as the source of supply for the tubes.

My clients agree as a result of my suggestion that your company having been the first to establish radio broadcasting on a permanent basis should be given an opportunity to investigate this situation before too many non-exclusive licenses have been executed. I am therefore writing you to invite any representative of your patent department, either from East Pittsburgh or Washington, to examine one of these house lighting circuit receivers in operation some evening in Washington.

I understand that you have examined the file wrapper of the above referred to patent and you are therefore familiar with the scope of the invention as thus far protected. Briefly this new receiver does not require primary or secondary batteries and enables power amplification tubes to be used giving amplification not possible with dry cell tubes. No storage batteries with chargers and all inherent difficulties are required. In short this receiver is the ultimate in that it can be installed in the home using a small loop and merely a plug connection

to the electric light socket. The hum of the alternating current is eliminated in this receiver. Standard three electrode tubes are used. It is not necessary with this receiver to go to special tubes which use an auxiliary filament heated from the A. C. source which filament in turn heats the electron emitting body as developed by your engineers.

These inventors have had in mind that the general public must be considered as laymen and that in order to sell them a radio receiver for home entertainment, the apparatus must require practically no connections nor skill in operation. This is accomplished in the present receiver, the loop being wired with the set, and a single control provided for tuning and a flexible cord with a screw plug adapter at the end thereof which plugs into an electric light socket in the same manner that a layman understands how a vacuum cleaner, fan or iron is to be plugged into a socket.

Will you please advise me whether you are interested in this situation and care to have your representative examine the receiver.

Yours very truly,

JBB:DMS

PLAINTIFFS' EXHIBIT NO. 53.

Pages 242-246, Inclusive, Transactions of American Institute of Electrical Engineers, April, 1922, "A Relay Recorder for Remote Control by Radio," by F. W. Dunmore. This Exhibit is the same as plaintiffs' Exhibit 53 printed at page 259 of Vol. 2 (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 54.

Page 441, Radio News for September, 1922, "Discarding Storage Batteries," by S. R. Winters. This Exhibit is the same as plaintiffs' Exhibit 21 printed at page 243, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 55.

Pages 501-505, Inclusive, The Electrical Journal, December, 1922, "A Practical Alternating Current Radio Receiving Tube," by H. M. Freeman. This Exhibit is the same as plaintiffs' Exhibit 55. By stipulation of Counsel this exhibit is treated as Physical Exhibit. See stipulation Vol. I, page 292.

PLAINTIFFS' EXHIBIT NO. 56.

Pages 32-35, Inclusive, Q S T, October, 1922, "Amplifier Operation From A. C. Supply," by P. D. Lowell. This Exhibit is the same as plaintiffs' exhibit 21 and is printed at pages 239-241, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 57.

Pages 21, 22, Telephone, September 16, 1922, Vol. 83, No. 12, "Batteryless Radio Receiving Set," by P. D. Lowell. This exhibit is the same as plaintiff's exhibit 21 and is printed at pages 245-247, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 58.

Pages 27, 28, "Radio" for September, 1922, "An Amplifier With A. C. Filament and Plat Supply," by P. D. Lowell. This exhibit is the same as plaintiffs' exhibit 21 and is printed at pages 233-235, Vol. II (Book of Exhibits).

PLAINTIFFS' EXHIBIT NO. 59.

Radio News for November, 1922, pages 838, 839, 1001, 1002, "Radio Messages Typed Automatically From Airplane to Ground," by S. R. Winters. This exhibit is the same as plaintiffs' exhibit 59 and is printed at pages 275-282, Vol. II (Book of Exhibits).

DEFENDANTS' EXHIBIT NO. 1.

Time Cards, monthly reports and laboratory note book of Francis W. Dunmore. This exhibit is the same as plaintiffs' exhibit 14. By stipulation of Counsel printed at page 292, Vol. I of record this Exhibit is certified as a physical exhibit.

DEFENDANTS' EXHIBIT NO. 7.

Memorandum of January 9, 1922, Lowell to Dellinger. This memorandum is included in the Time cards, monthly reports and laboratory note book of Percival D. Lowell constituting plaintiffs' Exhibit 83. By stipulation of Counsel this Exhibit is certified as a Physical Exhibit, Vol. I, Page 292.

MEMORANDUM.

By stipulation of Counsel the following exhibits referred to in the proffer of proof under rule 46 are here omitted, the same being treated as physical exhibits.

DEFENDANTS' EXHIBIT NUMBERS.

11 R C A Radiola 16 Service Notes
12 R C A Radiola 18 Service Notes
13 R C A Radiola 60 Service Notes

(Style of Court and Title Omitted.)

STIPULATION AS TO DEFENDANTS' EXHIBITS 11, 12 AND 13 REFERRED TO IN PROFFER OF EVIDENCE UNDER RULE 46 AS COVERED BY ITEM 3 IN STIPULATION AS TO RECORD ON APPEAL IN THIS CASE AND ADDENDUM TO TRANSCRIPT OF RECORD.

Filed 13th December, 1934.

(Style of Court and Title Omitted.)

It is hereby stipulated and agreed by and between counsel for the parties hereto that in lieu of the reproduction

in the printed record of defendant's Exhibits 11, 12 and 13 referred to in plaintiff's proffer of proof under Rule 46 in the instant case, that Exhibits 11, 12 and 13 may be treated as physical exhibits, providing, however, that any party hereto so desiring may submit to the Circuit Court of Appeals at the time of the argument of the above appeal three (3) copies of any of said Exhibits 11, 12 and 13.

And it is further stipulated and agreed by and between counsel that the Clerk of the District Court shall make up an addendum to the transcript of record and include therein the proffer of evidence offered under Rule 48, together with the exhibits referred to therein and shall certify the same accordingly

SEMMES, BOWEN & SEMMES,

By GAYLORD LEE CLARK,
Solicitor for Appellants.

C. V. EDWARDS, of Counsel,
COOK AND MARKELL,
CHAS. MARKELL,
Solicitors for Appellees.

SAMUEL E. DARBY, JR., of Counsel,

SEMMES, BOWEN & SEMMES,

By GAYLORD LEE CLARK,
Solicitors for Cross-Appellees.

C. V. EDWARDS, of Counsel,
COOK AND MARKELL,
CHAS. MARKELL,
Solicitors for Cross-Appellees.

SAMUEL E. DARBY, JR., of Counsel.

CLERK'S CERTIFICATE.

UNITED STATES OF AMERICA,

DISTRICT OF MARYLAND, To wit:

I, Arthur L. Spamer, Clerk of the District Court of the United States for the District of Maryland, do hereby certify that the foregoing is a true copy of Plaintiffs' Proffer of Evidence under Rule 46, together with the Exhibits therein referred to, which was offered at the trial of the case of Percival D. Lowell, Francis W. Dunmore and Dubilier Condenser Corporation, Plaintiffs, vs. A. G. Triplett, R. M. Triplett, A. Nelson, C. M. Triplett, Jr., and The Baltimore Gaslight Company, Defendants, No. 2193 Equity Docket in said District Court and which are now being certified as an Addendum to the Transcript of Record in the case entitled Percival D. Lowell, et al.; Appellants and Cross-Appellees, versus A. G. Triplett, et al., Appellees and Cross-Appellants, pending in the United States Circuit Court of Appeals for the Fourth Circuit.

In Testimony Whereof, I hereunto set my hand and affix the seal of said District Court this 17th day of December, 1934.

ARTHUR L. SPAMER,

(Seal) Clerk of said District Court.

December 20, 1934, the appearance of Gaylord Lee Clark is entered for the appellants and cross-appellees.

Same day, twenty-four copies of Volume One of the printed record are filed.

Same day, ten copies of Volume Two of the printed record are filed.

Same day, twenty-four copies of the printed addendum to the transcript of record are filed.

December 22, 1934, the appearance of Chas. Markell is entered for the appellees and cross-appellants.

January 4, 1935, stipulation as to the time for the filing of the respective briefs is filed.

February 2, 1935, original exhibits are certified up.

ARGUMENT OF CAUSE

February 7, 1935 (January term, 1935), cause came on to be heard before Parker and Soper, Circuit Judges, and McClintic, District Judge, and is argued by counsel and submitted.

OPINION—Filed June 3, 1935

UNITED STATES CIRCUIT COURT OF APPEALS, FOURTH CIRCUIT

No. 3816

(Argued February 7, 1935. Decided June 3, 1935)

PERCIVAL D. LOWELL, FRANCIS W. DUNMORE and DUBILIER CONDENSER CORPORATION, Appellants and Cross Appellees,

versus

A. G. TRIPLETT, R. M. TRIPLETT, A. NELSON, C. M. TRIPLETT, JR., and THE BALTIMORE GASLIGHT COMPANY, Appellees and Cross Appellants

Cross-Appeals from the District Court of the United States for the District of Maryland, at Baltimore. In Equity

Before Parker and Soper, Circuit Judges, and McClintic, District Judge

Clifton V. Edwards (Gaylord Lee Clark and John B. Brady on brief) for appellants and cross-appellees, and

Samuel E. Darby, Jr. (Cook & Markell on brief), for appellees and cross-appellants.

SOPER, Circuit Judge:

The three United Sates patents involved in this suit, namely, Lowell and Dunmore, No. 1,455,141, Dunmore, No. 1,635,117, and Dunmore and Lowell, No. 1,606,212, were involved in three earlier suits in the District Court of Delaware, Dubilier Condenser Corporation et al. vs. Radio Corporation of America, 34 F. (2d) 450, wherein it was held that the first two patents were valid and infringed, and that the third patent was not infringed. Plaintiffs did not appeal from the adverse decision upon the third patent, but the Radio Corporation of America prosecuted appeals from the favorable decisions on the other patents; and the Circuit Court of Appeals for the Third Circuit reversed the decree of the District Court as to these patents, and held the claims involved, to wit, claims 3 and 14 of patent No. 1,455,141, and claim 9 of patent No. 1,635,117, to be invalid as covering mere aggregations devoid of invention and unpatentable in view of the prior art. Radio Corp. vs. Dubilier Condenser Corp., 59 F. (2d) 305, 309. On October 25, 1932, certiorari was denied by the Supreme Court as to patent No. 1,455,141, because it was not applied for in time, and as to patent No. 1,635,117 without statement of reason. (287 U. S. 647, 650.)

The claims in suit in the pending case are claims 1 to 4 and claims 13 and 14 in patent No. 1,455,141; claims 9, 11 and 12 of patent No. 1,635,117, and claims 1 to 9 in patent No. 1,606,212.

The nature of the devices is fully described in the opinion of Judge Morris in the District Court of Delaware. For our present purposes, it is sufficient to say that all of the patents in suit relate to the use in radio receiving sets of alternating current from an ordinary household lighting circuit, in lieu of direct current from A and B batteries and storage cells. The standard 110 volt alternating current, used for lighting purposes, has a frequency of 60 cycles per second, and these continual reversals or alternations produce a distortion of modulation, and a strong

hum in the sound ouput of a radio receiving set, that make the reception unsatisfactory. The elemination of these disadvantages was the problem which the patentees sought to solve.

In patent No. 1,455,141, eliminating means are disclosed for the radio frequency amplifier portion, the detector portion and the audio frequency amplifier portion, into which the receiver is divided. Patent No. 1,635,117 relates to the operation of the audio frequency amplifier by alternating current. The immediate application of the patent is in connection with a device for the radio operation of telegraph instruments, but the patent points out the use of the amplifier in radio receivers. Patent No. 1,606,212 relates to the use of an audio frequency amplifier and loud speaker operated by alternating current. A coil armature and an electro magnetic field coil are used, and the patent teaches that the hum can be eliminated by the relation in which the windings of these coils are connected.

On July 8, 1933, more than eight months after the denial of the petitions for writs of certiorari by the Supreme Court, the plaintiff filed in the Patent Office a disclaimer with respect to certain claims of patent No. 1,455,141 including claims 3 and 14, which had been held invalid in the Third Circuit, and also a disclaimer with respect to certain claims of patent No. 1,635,117, including claim 9, which had also been held invalid. None of the invalidated claims were cancelled by the disclaimers. The purpose of the disclaimers was to ensure that the broad language of the claims would be given more definite meaning by reference to the disclosures of the patent so as to cover what is there described, or the equivalent thereof, in accordance with the well established rule that in interpreting the language of a claim, the words are not to be taken literally but in the sense in which they were used by the inventor as disclosed in his specification. Elevator Supplies Co. v. Graham & Norton Co., 44 F. (2d) 354; Westinghouse v. Boyden Power Brake Co., 170 U. S. 537, 568, 569.

The bill of complaint in the present suit was filed on August 17, 1933, against alleged infringers, who were not parties to the suit in the Third Circuit, in order to obtain

another hearing upon the merits of these claims, and to secure a decree upholding their validity. When the case was called for trial, defendants moved to dismiss the bill as to the first two patents in suit on the ground that the disclaimers had not been filed within a reasonable period after the final adjudication in the Third Circuit, as required by the provisions of the federal statutes, R. S. Sections 4917 and 4922, 35 U. S. C. A. 65, 71. The gist of these sections and the interpretation to be placed upon them is thus set out in Ensten v. Simon, Ascher & Co., 282 U. S. 445, 450, 452, 453:

"The first of these sections provides in substance that whenever, through inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, a patentee has claimed more than that of which he was the original or first inventor or discoverer, he may be permitted to make disclaimer of such parts of the thing patented as he shall not choose to claim or hold by virtue of his patent. The other permits the patentee to maintain a suit on his patent, although through inadvertence, accident, or mistake, and without any wilful default or intention to mislead the public, he has claimed some material or substantial part as an invention of which he was not the original or first inventor. He is deprived, however, of the right to recover costs, unless he has filed proper disclaimer before commencement of his suit. And it further provides: "But no patentee shall be entitled to the benefits of this section if he has unreasonably neglected or delayed to enter a disclaimer."

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"Under the early accepted general rule a patent with an invalid claim was wholly void, and this defect effectually barred suit upon it. Congress undertook to modify this * * *. The two sections "are parts of one law, having one general purpose, and that purpose is to obviate the inconvenience and hardship of the common law which made a patent wholly void if any part of the invention was wrongfully claimed by the patentee, and which made such a defect in a patent an effectual bar to a suit brought upon it." * * * Construed together they "enact that where a pat-

entee claims materially more than that which he was the first to invent, his patent is void, unless he has preserved the right to disclaim the surplus; and that he may fail to preserve that right, by unreasonable neglect or delay to enter a disclaimer in the Patent Office."

* * * * * * *

"The statute is remedial; the intent is to aid the inventor free from wilful default or intention to mislead the public by permitting him to avoid the consequence of inadvertence, accident or mistake through prompt disavowal of the apparent right to exclude others from something improperly included in the words of his grant. Escape is permitted only to one who acted originally in good faith and who has complied with the prescribed conditions."

"The same principle which forbids a patentee to assert a right to more than he has actually invented compels him to disavow the right as soon as he discovers that it has been unjustly claimed. Unreasonable delay in disclaiming is thus tantamount to an original fraudulent claim, and through it the patentee loses the privilege of making the amendment by which alone his patent could be saved. The question of unreasonable delay is a question for the court, upon the facts as found either by its own investigation or the verdict of a jury. Delay begins whenever the patentee becomes aware that he has claimed more than he has invented or described."

The motion to dismiss was denied by the District Judge, since, in his opinion, the delay was not unreasonable in view of the mass of prior litigation affecting the patents and the complexity of the subject matter. This ruling is challenged in view of decisions more fully discussed in an opinion of this court filed May 1, 1935, in The General Chemical Company v. Standard Wholesale Phosphate and Acid Works, which indicate that disclaimers should be promptly filed. However this may be, the ruling was not prejudicial to the defendants because of the final disposition of the case. Subsequently, the defendants amended their answer raising the defense that the two patents are invalid, not only on account

of the unreasonable delay in filing the disclaimers, but also because the disclaimers were inadequate. On the latter ground, the defendant again moved the court to dismiss the bill as to these two patents. During the discussion that followed, the plaintiff made an offer of proof in written form, under Equity Rule No. 46, in regard to these patents, and this was filed; but the District Judge, being of the opinion that the disclaimers were inadequate, granted the motion to dismiss. He rested his conclusion primarily on the ground that when a court of the United States is prima facie satisfied that a matter has been thoroughly litigated in another circuit and has been correctly decided by the Court of Appeals thereof, and certiorari has been refused by the Supreme Court, the decision should be accepted as binding, and the court should not be required to consider the same testimony, and perhaps some additional testimony, merely to afford the losing party an opportunity to persuade another tribunal to reach a different conclusion. The District Judge, having studied the opinion of the Third Circuit and believing it to be sound, declined to receive the proffered testimony and dismissed the bill as to the two patents.

In this action, there was, in our view, prejudicial error, for without expressing any opinion as to the merits of the patents in suit, we think that the plaintiff was entitled to present its case for the consideration of the judge in the usual manner, and to secure from him the exercise of his individual judgment, taking into consideration, of course, the light thrown on the subject by the earlier decisions, but deciding the case according to his own convictions. Such a course would require not merely a careful study of the prior decisions, but a hearing de novo of the evidence offered and a determination based thereon.

The following observation upon the weight to be given by one circuit to the prior decisions of another, was made by the Supreme Court in Mast, Foos & Co. v. Stover, 177 U. S. 485, 488, a suit upon a patent:

"Comity is not a rule of law, but one of practice, convenience and expediency. It is something more than mere courtesy, which implies only deference to the opinions of others, since it has a substantial value in securing uni-

formity of decision, and discouraging repeated litigation of the same question. But its obligation is not imperative. If it were, the indiscreet action of one court might become a precedent, increasing in weight with each successive adjudication, until the whole country was tied down to an unsound principle. Comity persuades; but it does not command. It declares not how a case shall be decided, but how it may with propriety be decided. It recognized the fact that the primary duty of every court is to dispose of cases according to the law and the facts; in a word, to decide them right. In doing so, the judge is bound to determine them according to his own convictions. If he be clear in those convictions, he should follow them. It is only in cases where, in his own mind, there may be a doubt as to the soundness of his views that comity comes in play and suggests a uniformity of ruling to avoid confusion, until a higher court has settled the law. It demands of no one that he shall abdicate his individual judgment, but only that deference shall be paid to the judgments of other coordinate tribunals. Clearly it applies only to questions which have been actually decided, and which arose under the same facts."

See also Sanitary Refrig. Co. v. Winters, 280 U. S. 30, 35. To the same effect is the following statement of this court in Imperial Bottle Cap & Machine Co. v. Crown Cork & Seal Co., 139 F. 312, 313:

"* * * The parties before us have the right to our individual judgment, and considerations of convenience and expediency must give way to demands of duty, from which we cannot be absolved by the doctrine of comity."

It follows, that the case as to these two patents must be remanded to the District Court for further proceedings, unless the dismissal of the bill as to them can be sustained on some other ground. The defendants urge, as a sufficient reason for the dismissal, that the disclaimers were not filed within a reasonable time after the denial of the writs of certiorari, 8 months and 13 days having intervened; and also that apart from the delay, the papers actually filed were entirely inadequate for the purpose.

We may assume, for the purposes of the pending case, that in effect no disclaimer has been filed as to the claims passed on in the Third Circuit, for even if the delay of 8 months is satisfactorily accounted for, the plaintiff admits, as the defendants contend and the District Judge held, that the so-called disclaimers disclaimed nothing and amounted only to an admission that the broad language of the claims should be limited to the disclosures of the specifications, in accordance with the well established rule.

Stated broadly, the proposition of the defendants means that a decision of invalidity, with respect to a claim of a patent in one federal circuit, is conclusive as to that claim, because the patent may never again form the subject matter of a suit unless a disclaimer as to the particular claim has been filed within a reasonable time after the adverse decision. The defendants contend that this result necessarily follows from the interpretation given to the disclaimer statutes by the Supreme Court in Ensten v. Simon, Ascher & Co., supra, and by other courts in R. Hoe & Co. v. Goss Printing Press Co., 31 F. (2d) 565; Radio Condenser Co. v. General Ins. Co., 65 F. (2d) 458; Emery v. J. G. McCrory Co., 4 F. Supp. 167. The patent considered by the Supreme Court in Ensten v. Simon, Ascher & Co., supra, had been previously litigated in the District Court of the Northern District of Ohio, which had held that claims 1, 3, 4, and 5 of the patent were valid and infringed, but that claim 2 was invalid. On appeal by the defendants as to the ruling on the first mentioned claims, the decree was affirmed, but no appeal was taken by the plaintiff as to the adverse ruling on claim 2. More than six months after the mandate was issued from the Circuit Court of Appeals, and 23 months after the decision of the District Court, a disclaimer was filed. Later, a bill based on the same patent against another defendant was presented to the District Court of the Southern District of New York, and the bill was dismissed because of unreasonable delay in filing the disclaimer. This decree the Supreme Court affirmed, pointing out that the owner of the patent might have appealed from the adverse decision on claim 2 and thus have secured an early determination of his rights, but instead of doing this, he con-

tinued to hold himself out as the sole possessor of the patent right for nearly 2 years, and then abandoned it. Thereby he failed to bring himself within the protection of the statute. It will be observed that in contrast with the admission of invalidity in this case, the owner of the patents in the pending case has made no concession of invalidity, all parties agreeing that the disclaimers left the matter in the same situation as if no disclaimer had been filed. The plaintiffs insist upon the validity of the claims and base their suit in part thereon.

In R. Hoe & Co. v. Goss Printing Press Co., supra, the Circuit Court of Appeals had previously decided (30 F. (2d) 271), that one claim of a patent was valid and ten claims were invalid, and the plaintiff had applied for an interlocutory decree on the valid claim in the District Court. Thereupon the defendant demanded that the plaintiff file a disclaimer as to the other claims as a condition of proceeding, and on defendant's motion, the Circuit Court of Appeals amended its mandate so as to require a disclaimer. The court said that the patentee could not wait until he had an opportunity to test the validity of the invalidated claims in another circuit; for this might conceivably postpone the filing of the disclaimer until all nine circuits had passed on the subject, and thereby extend the period unreasonably. The practical effect of this decision is that when a claim of a patent has been finally decided to be invalid in a federal circuit, the owner of the patent may not proceed further in that circuit in the same case or in any other case based upon the patent, unless he promptly files a disclaimer, for all doubt as to the invalidity of the claim will have been settled so far as that circuit is concerned.

In Radio Condenser Co. v. General Ins. Co., 65 F. (2) 458, the right to sue on a counterclaim based on certain claims of two patents was held to have been properly denied by the District Court for the Southern District of New York, because several years previously, these claims had been held invalid in interference proceedings in the Patent Office, and in the interval, the patentee had neither taken an appeal nor attempted otherwise to litigate the patent, nor filed disclaimers.

In Emery v. J. G. McCrory Co., 4 F. Supp. 167, certain claims of a patent sued on in the Eastern District of New York had previously been held invalid in a suit in the Sixth Circuit, and while the latter suit was pending, a suit had been started by the plaintiff on the same patent in the Southern District of New York, during the pendency of which the suit at bar was commenced. Later, the suit in the Southern District of New York was dismissed for want of prosecution. The District Court held, upon the authority of R. Hoe & Co. v. Goss Printing Press Co., supra, that the suit must fail because a disclaimer had not been filed; but it was intimated that the result might have been different if the suit in the Southern District of New York had not been dismissed.

It is established by the decision of the Supreme Court in the Ensten case, that if the owner of a patent has become aware, through adverse decision or other means, that a claim of his patent is void, and fails to file a disclaimer thereof within a reasonable time, he is in the position of one who, with knowledge of the invalidity, has failed to relieve the public of the evil effects of a false and misleading assertion, and he may not thereafter bring suit on any other claim of the patent, even though it be good, for the whole patent has become void. In conformity with this rule, the practice has been adopted in a number of federal circuits, in the event of an adverse decision upon the claim of a patent in a case on trial, to require the filing of a disclaimer of the void claim within 30 or 60 days, as a condition of proceeding further in the case upon the valid claims. Herman v. Youngstown Car Mfg. Co., 191 F. 579; Higgin Mfg. Co. v. Watson, 263 F. 378, 387; Excelsior, &c., Co. v. Williamson Heater Co., 269 F. 614, 619; Liquid Carbonic Co. v. Gilchrist, 253 F. 54; R. Hoe & Co. v. Goss Printing Press Co., 31 F. (2d) 565. The courts in the Second Circuit have also had occasion, as in Radio Condenser Co. v. General Ins. Co., supra, to apply the rule to a case in which a patentee has acquiesced in an adverse decision upon a petition in one jurisdiction, and has thereafter, without filing a disclaimer, attempted to relitigate the patent in another jurisdiction after an unexplained delay of several

years; and these courts have held that under these circumstances, the latter suit was barred.

These decisions, however, do not, in our opinion, control the pending case or require the dismissal of the bill of complaint. Here the owner of the patent made no concession of invalidity of the claims, even in the disclaimers filed on July 8, 1933; but, on the contrary, within a month thereafter, reasserted the validity of the claims in the pending suit. We do not think that the owner of a patent, who desires, after an adverse decision thereon, to obtain the decision of another court, is to be held to the same rigid rule as to prompt action, as is required for the filing of a disclaimer as to a claim which he concedes to be invalid. In the ordinary case, the owner of a patent can, without difficulty, determine whether or not to file a disclaimer within a relatively short time, for all the circumstances necessary for the decision are immediately available. On the other hand, when he is unwilling to disclaim and desires to obtain the determination of a court of another jurisdiction upon the questions involved, by suit against another infringer, a longer period may reasonably be taken without the loss of the patent rights. We are unable to say in the pending case that the interval which elapsed between the denial of certiorari by the Supreme Court in Radio Corporation v. Dubilier Condenser Corporation, supra, and the filing of the pending suit was so unreasonably long as to destroy the privilege of a second trial in another court.

The mere filing of a disclaimer does not involve the admission that the patent is void if the disclaimer is not adequate. Permutit Co. v. Wadham, 13 F. (2d) 454; Permutit Co. v. Harvey Laundry Co., 279 F. 713; National Food Products Co. v. C. H. Musselman Co., 8 F. Supp. 994; Metropolitan Device Corp. v. Cleveland Elec. Ill Co., 36 F. (2d) 477; Seiberling v. John E. Thropp's Sons Co., 284 F. 746. If the owners of the patents in the pending case are correct in their contentions, (notwithstanding the decision of the Third Circuit), that claims 3 and 14 of patent No. 1,455,141, and claim 9 of No. 1,635,117 are valid, and that no disclaimers were necessary under the law to save the patents, it is immaterial that disclaimers which contain no concession of

invalidity were in fact filed, for no one was prejudiced thereby. Carnegie Steel Co. v. Cambria Iron Co., 185 U. S. 403, 435, 436. Compare Altoona Publix Theatres, Inc. v. American Tri-Ergon Corporation, 55 Sup. Ct. 455, 462. On the other hand, if the decision of the Third Circuit should be followed in the pending case, the plaintiff's suit must fail on account of the inadequacy of the disclaimers, not only as to the claims held void in the previous case, but also as to all of the remaining claims, even though some of them may be good; for it would then be established that the owner of the patent had failed to file disclaimers within a reasonable time after notice of the invalidity of some of the claims had been brought home to him.

The long continued practice in patent cases is inconsistent with the defendants' contention that an adverse decision on any claim of the patent requires the prompt filing of a disclaimer thereof, with the result that it may never be litigated again. There are many cases in the books in which decisions adverse to a patent in one circuit have been followed by favorable decisions in another circuit, and generally it is well established that a decision in one circuit, while persuasive, is not binding on the courts of another in litigation upon the same patent between different parties. Mast, Foos & Co. v. Stover, 177 U. S. 485; Sanitary Refrig. Co. v. Winters, 280 U. S. 30, 35. In some of these cases, the original decision of invalidity has related to the entire patent, while in others, it has related to some of the claims only; but it is obvious that the principle underlying the right to litigate the patent again is the same in the first class as it is in the latter, for an adverse decision as to the entire patent should certainly be given as much weight as one in which only some of the claims have been invalidated. The only cases to which our attention has been called tending to show that a decision of invalidity in one circuit is conclusive in all, are hereinbefore cited. On the other hand, cases are listed in the note in which the Supreme Court has passed on the merits of patents first held invalid in one circuit, and later, held valid in another circuit; and also cases in the Circuit Court of Appeals where the patent was first held invalid in one circuit and later held valid in an-

other (omitting cases which reached the Supreme Court).* Numerous cases might also be cited in which one Circuit Court of Appeals has held a patent valid, and another Circuit Court of Appeals has later held the patent invalid.

The opportunity afforded the owner of a patent in these cases to litigate anew the claims of a patent previously held invalid, is analogous to the opportunity afforded a defendant accused of infringment of a patent previously held valid

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* Cases in the Supreme Court prior to the establishment of the Circuit Courts of Appeals:

The Barbed Wire Patent, 143 U. S. 275, although no diversity of opinion existed in the lower Courts, indicates the practice prior to the Act establishing the Circuit Courts of Appeal.

The original patent had been held to be invalid by the Circuit Court for the Northern District of Illinois (Washburn and Moen v. Haish, 4 Fed. 900). The patent was then reissued and in Washburn & Moen Mfg. Co. v. Fuchs, 16 Fed. 661, 667, the Circuit Court for the Eastern District of Missouri held the reissue to be unwarranted and void. Suits were then brought upon the original patent in the Circuit Court for the Northern District of Iowa (Washburn & Moen Mfg. Co. v. Beat 'Em All Barbed Wire Co., 33 Fed. 261), the patent was again held invalid. The Supreme Court held the original patent to be valid.

Cases in the Supreme Court where the patent was held invalid by the Circuit Court of Appeals in one circuit, and later held valid by the Circuit Court of Appeals in another circuit:

Expanded Metal Co. v. Bradford, 214 U. S. 366. The patent was held to be invalid by the Circuit Court of Appeals for the Third Circuit (Bradford v. Expanded Metal Co., 146 Fed. 984). After the decree in the Circuit Court of Appeals for the Third Circuit plaintiff filed a bill against another defendant in the Northern District of Ohio. The District Court held the patent to be invalid on the authority of the case in the Circuit Court of Appeals for the Third Circuit (157 Fed. 564). On appeal the Circuit Court of Appeals for the Sixth Circuit reversed this finding and held

by the courts of another circuit to try again the issue of validity. It is conceded that this advantage still exists, and that in no case is an alleged infringer bound by the decisions in cases to which he was not a party. No reason has been suggested as to why a decision of invalidity should be given a finality denied to one favorable to the existence of the invention; and no distinguishing reason occurs to us. Not infrequently in the past, a patent first held invalid for lack of invention has ultimately been sustained; and it has been established that the first decision was in error. Obviously, similar mistakes may be made in the future, and so

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the patent to be valid (Expanded Metal Co. v. General Fireproofing Co., 164 Fed. 849). On certiorari from the decree in the Sixth Circuit the Supreme Court held the patent to be valid.

Diamond Rubber Co. v. Consolidated Rubber Tire Co., 220 U. S. 428. The patent was held to be invalid by the Circuit Court of Appeals for the Sixth Circuit in Goodyear Tire & Rubber Co. v. Rubber Tire Wheel Co., 116 Fed. 363; also by the same Court in Rubber Tire Wheel Co. v. Victor Rubber Tire Co., 123 Fed. 85. In subsequent litigation the Circuit Court of Appeals for the Second Circuit held the patent to be valid. Consolidated Rubber Tire Co. v. Firestone Tire & Rubber Co., 151 Fed. 237; also in Consolidated Rubber Tire Co. v. Diamond Rubber Co., 162 Fed. 892. The Supreme Court held the patent to be valid.

Dowagiac Mfg. Co. v. Minnesota Moline Plow Co., 235 U. S. 641 did not involve the validity of the patent, but the Circuit Court of Appeals for the Sixth Circuit had held plaintiff to be entitled to defendant's entire profits. Brennan & Co. v. Dowagiac Mfg. Co., 162 Fed. 472. Subsequently the Circuit Court of Appeals for the Eighth Circuit held plaintiff to be entitled only to nominal damages. Dowagiac Mfg. Co. v. Minnesota Moline Plow Co., 183 Fed. 314. The Supreme Court, after stating the law, substantially followed the ruling of the Eighth Circuit but reversed the decree for special reasons.

Hanover Star Milling Co. v. Metcalf, 240 U. S. 403. A suit on the trademark "Tea Rose" was dismissed by the Circuit Court of Appeals for the Fifth Circuit (Metcalf

long as the burden is imposed upon the owner of the patent to sustain the validity thereof in every suit which he brings it does not seem just to deny him the corresponding privilege of testing more than once adverse decisions against him. With these considerations in mind, we are of the opinion that the disclaimer statutes should not be given the broad interpretation and effect for which the defendants contend and we conclude that the plaintiff was entitled to a trial of the issues raised as to the first two patents in the District Court, and that the case must therefore be remanded for further proceedings.

Evidence was taken as to the third patent, No. 1,606,212, in the District Court, and the conclusion was reached that

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v. Hanover Star Milling Co., 204 Fed. 211). In a suit in the Seventh Circuit filed shortly before the decision in the Fifth Circuit, the Circuit Court of Appeals for the Seventh Circuit upheld plaintiff's rights in part (Hanover Star Milling Co. v. Allen and Wheeler Co., 208 Fed. 513). Because of a diversity upon fundamental questions the Supreme Court took both cases and decided the questions in dispute.

Railroad Supply Co. v. Elyria Iron Co., 244 U. S. 285. In copending cases the patent was held invalid by the Circuit Court of Appeals for the Sixth Circuit. Railroad Supply Co. v. Elyria Iron Co., 213 Fed. 789, and valid by the Circuit Court of Appeals for the Seventh Circuit. Railroad Supplies Co. v. Hart Steel Co., 222 Fed. 261. The Supreme Court held the patent invalid.

Abercrombie & Fitch Co. v. Baldwin, 245 U. S. 198. The original Letters Patent was held invalid by the Circuit Court of Appeals for the Seventh Circuit (Bleser v. Baldwin, 199 Fed. 133). The patent was then reissued and the reissue held void by the Circuit Court of Appeals for the Third Circuit (Grier Bros. v. Baldwin, 219 Fed. 735). The Circuit Court of Appeals for the Second Circuit then held the reissue patent to be valid (Baldwin v. Abercrombie & Fitch Co., 228 Fed. 895). The Supreme Court held the patent to be valid and subsequently (Simmons Co. v. Grier Bros. Co., 258 U. S. 82) upheld an application to reopen the case in the Third Circuit.

the patent was valid and infringed, and from the decree based thereon the defendant has appealed, so that the matter is before us for decision. The subject matter of this patent, however, is so closely allied with that of the other patents in suit that we deem it unwise to pass on its merits until the whole controversy is before us. The whole case will therefore be remanded to the District Court with leave to the parties to take testimony, including additional testimony as to patent No. 1,606,212, if they see fit, and with leave to the court to reaffirm or modify or reverse its former decree as to this patent after the evidence on all of the

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T. H. Symington v. National Malleable Castings Co., 250 U. S. 383. The question was one of priority as between Emerick and Byers. The Circuit Court of Appeals for the Seventh Circuit held that Emerick was prior (Miner v. T. H. Symington Co., 229 Fed. 730). Subsequently the Circuit Court of Appeals for the First Circuit held Byers to be prior (National Malleable Castings Co. v. T. H. Symington Co., 230 Fed. 821). The Supreme Court held Byers to be the prior inventor.

Meccano, Ltd. v. John Wanamaker, 253 U. S. 136. The District Court in the Southern District of Ohio upheld the patent. The Circuit Court of Appeals for the Sixth Circuit (246 Fed. 603) reversed the District Court and held the patent invalid. Meanwhile suit had been brought in the Southern District of New York where a preliminary injunction was granted and an appeal was taken therefrom. After the decision of the Circuit Court of Appeals for the Sixth Circuit, motion was made before the Circuit Court of Appeals for the Second Circuit to dismiss the New York case. The Circuit Court of Appeals for the Second Circuit (Meccano, Ltd. v. John Wanamaker, 250 Fed. 250) denied the motion and subsequently (Meccano v. John Wanamaker, 250 Fed. 50), reversed the order granting a preliminary injunction, at the same time expressing the opinion that the patent was invalid. On certiorari the Supreme Court affirmed the Second Circuit, stating that the matter for review was "upon the preliminary order for injunction and we

patents has been taken, and the entire case presented for the final determination of the court.

Reversed and remanded for further proceedings.

DECREE—Filed and entered June 4, 1935

UNITED STATES CIRCUIT COURT OF APPEALS, FOURTH CIRCUIT

No. 3816

PERCIVAL D. LOWELL, FRANCIS W. DUNMORE and DUBILIER CONDENSER CORPORATION, Appellants and Cross-Appellees,

vs.

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may go no further," and remanded the cause to the District Court for further proceedings.

New York Scaffolding Co. v. Chain Belt Co., 254 U. S. 32. After the Circuit Court of Appeals for the Eighth Circuit had held the patent to be invalid (New York Scaffolding Co. v. Whitney, 224 Fed. 452), and the Circuit Court of Appeals for the Third Circuit had held the patent to be invalid (New York Scaffolding Co. v. Liebel-Binney Construction Co., 243 Fed. 577), the Circuit Court of Appeals for the Seventh Circuit held the patent to be valid (Chain Belt Co. v. New York Scaffolding Co., 245 Fed. 747). The Supreme Court held the patent to be invalid.

John E. Thropp's Sons Co. v. Seiberling, 264 U. S. 320. The Circuit Court of Appeals for the Sixth Circuit held two claims invalid (Seiberling v. Firestone Tire & Rubber Co., 257 Fed. 74). After qualified disclaimers the Circuit Court of Appeals for the Third Circuit held the patent as qualified by the disclaimers valid (284 Fed. 746). The Supreme Court held the patent to be invalid.

Corona Co. v. Dovan Co., 276 U. S. 358. The patent was first held invalid by the Circuit Court of Appeals for the Second Circuit. Dovan Chemical Co. v. National Aniline & Chemical Co., 292 Fed. 555. The patent was then held

A. G. TRIPLETT, R. M. TRIPLETT, A. NELSON, C. M. TRIPLETT, JR., and The Baltimore Gaslight Company, Appellees and Cross-Appellants

Cross-Appeals from the District Court of the United States for the District of Maryland

This cause came on to be heard on the transcript of the

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valid by the Circuit Court of Appeals for the Third Circuit (10 Fed. [2d] 298). The Supreme Court held the patent to be invalid.

Saranac Machine Co. v. Wirebounds Co., 282 U. S. 704. The patent was held invalid by the Circuit Court of Appeals for the Seventh Circuit in Wirebounds Patents Co. v. Gibbons Box Co., 25 Fed. (2d) 363. Subsequently the Circuit Court of Appeals for the Sixth Circuit held the patent valid and infringed. (37 Fed. [2d] 830). The Supreme Court held the patent invalid.

Radio Corp. v. Radio Laboratories, 293 U. S. 1. After the Supreme Court had held DeForest to be the prior inventor the Circuit Court of Appeals for the Second Circuit held Armstrong to be the inventor. 66 Fed. (2d) 768. The Supreme Court upheld DeForest.

Cases in Circuit Courts of Appeals where the patent was first held to be invalid by one Circuit Court of Appeals and later held to be valid by another Circuit Court of Appeals (omitting cases which reached the Supreme Court):

Maitland v. Goetz, 86 Fed. 124 (Second Circuit). Stiringer patent held invalid by Circuit Court of Appeals for the Third Circuit (Maitland v. Gibson, 63 Fed. 840). Patent then surrendered and reissued by narrowing claim 1. The reissued claim 1 held valid by Circuit Court of Appeals for the Second Circuit.

McNeely v. Williames, 96 Fed. 978 (third Circuit). Certain claims were held invalid in 1890 by the Circuit Court of Appeals for the Second Circuit (Williames v. Barnard, 41 Fed. 358), the opinion stating that on filing a disclaimer of the claims held invalid complainants were entitled to a decree upon the other claims. Apparently no appeal was taken by the defendant and at that time plaintiff had no right of appeal from the dismissal. For some reason not apparent on the record a decree was, according to the opin-

record from the District Court of the United States for the District of Maryland, and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged, and decreed by this Court that the decree of the said District Court in this cause be, and the same is hereby, reversed; that this cause be, and the same is hereby, remanded to the District Court of the United States for the

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ion of the Court in the Third Circuit (p. 980), entered on June 11, 1892, without any disclaimer having been filed.

Suit was brought in the Third Circuit on January 27, 1893. Defendant asserted (p. 980) that "the patent in suit is wholly void by reason of unreasonable neglect or delay" to enter a disclaimer. The Circuit Court of Appeals for the Third Circuit held (p. 986):

"We must, therefore, hold that the Reid and Billington apparatus did not anticipate any of the claims of the patent in suit, and consequently that Williames was under no obligation to enter a disclaimer."

and held the patent valid.

Westinghouse Company v. Stanley Co., 133 Fed. 167 (First Circuit). The patent was held invalid by the Circuit Court of Appeals for the Second Circuit (Westinghouse Co. v. Catskill Co., 121 Fed. 831), holding plaintiff's attempted antedating proofs to be insufficient. The Circuit Court of Appeals for the First Circuit upon more complete proofs held the patent valid. So did the Circuit Court of Appeals for the Seventh Circuit in Diamond Meter Co. v. Westinghouse, 152 Fed. 704.

Thomson-Houston Co. v. Black River Traction Co., 135 Fed. 759 (Second Circuit). In this case the patent had been held invalid by the Circuit Court of Appeals for the Second Circuit in Thomson-Houston Elec. Co. Union Ry. Co., 86 Fed. 636, and also by the Circuit Court of Appeals for the Sixth Circuit in Thomson-Houston Elec. Co. v. Jeffrey Mfg. Co., 101 Fed. 121. Subsequently the patent was reissued. In the previous litigation (86 Fed. 636) plaintiff urged that the claim contains certain features by implication and therefore was not anticipated. The reissue specification contained a disclaimer limiting the claim to the features in question. It was held that the reissued claim was not for different inventions, and that the claim was valid.

District of Maryland, at Baltimore, for further proceedings in accordance with the opinion of the Court filed herein; and that the costs be paid by the appellants and cross-appellees.

Morris A. Soper, U. S. Circuit Judge.

June 4, 1935.

Imperial Bottle Cap & Machine Co. v. Crown Cork & Seal Co., 139 Fed. 312 (Fourth Circuit). Pending consideration of the case by this Court, the Circuit Court of Appeals for the Second Circuit held the patent invalid (Crown Cork & Seal Co. v. Standard Stopper Co., 136 Fed. 841). This Court, recognizing the doctrine of comity, nevertheless held the patent to be valid.

Peiper v. S. S. White Dental Co., 228 Fed. 30 (1915). Patent held valid and infringed by the Circuit Court of Appeals for the Seventh Circuit. Previously in 1908 the patent had been held invalid by the Circuit Court of Appeals for the Seventh Circuit. Peiper v. Electro Dental Mfg. Co., 160 Fed. 930.

In Backstay Machine & Leather Co. v. Hamilton, 262 Fed. 411 (1920), certain claims were held invalid. In a subsequent suit, Backstay Machine & Leather Co. v. Zenite Metal Co., 293 Fed. 23, the Circuit Court of Appeals for the Seventh Circuit held the same claims to be valid and infringed.

In Wenborne-Karpen Dryer Co. v. Cutler Dry Kiln Co., 290 Fed. 625 (1923), the Circuit Court of Appeals for the Second Circuit held the patent void for lack of invention. After the decision in the Second Circuit the defendant, in a pending suit in the Sixth Circuit, moved to dismiss upon the ground of privity between the parties. The Circuit Court of Appeals in the Sixth Circuit overruled the plea of privity, reversed a decree of the lower Court dismissing the bill, and remanded the case for hearing on the merits. Wenborne-Karpen Dryer Co. v. Dort Motor Car Co., 14 Fed. (2d) 378.

In Franc. Strohmeyer v. Arthur Siegman, 27 Fed. (2d) 785, the patent was held valid after it had been held invalid by the Circuit Court of Appeals for the Sixth Circuit, Forchheimer v. Franc, Strohmeyer, 20 Fed. (2d) 553.

On another day, to-wit, July 5, 1935, the mandate of this Court in this cause is issued and transmitted to the United States District Court at Baltimore, Maryland, in due form.

Same day, the original petition for appeal, order allowing appeal, petition for cross-appeal, order allowing cross-appeal, original exhibits and original stipulation waiving bonds are returned to the Clerk of the United States District Court at Baltimore, Maryland.

CLERK'S CERTIFICATE

UNITED STATES OF AMERICA,
Fourth Circuit, ss:

I, Claude M. Dean, Clerk of the United States Circuit Court of Appeals for the Fourth Circuit, do certify that the foregoing, together with 603 pages of Exhibits bound together in a separate binding entitled "Book of Exhibits", being Volume Two, and certified accordingly, is a true copy of the entire record and proceedings in the therein entitled cause, as the same remain upon the records and files of the said Circuit Court of Appeals.

In testimony whereof I hereto set my hand and affix the seal of the said United States Circuit Court of Appeals for the Fourth Circuit, at Richmond, Virginia, this 12th day of July, A. D. 1935.

Claude M. Dean, Clerk, U. S. Circuit Court of Appeals, Fourth Circuit. (Seal United States Circuit Court of Appeals, Fourth Circuit.

SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed December 9, 1935

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the Fourth Circuit is granted. And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.